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Battelle Technical Review

ENGINEERING LIB.

IN THIS ISSUE: New Directions in Petroleum Exploration and Production

VIGNETTE

PALMER B. STICKNEY

A substantial part of the continually mounting demand for materials with unusual properties has been met in recent years by the polymer chemist. It appears that this trend will certainly continue. "Indeed," states Battelle chemist Palmer B. Stickney, "tailor-made polymers—or polymers having controlled structures—can solve many materials problems. Moreover, new and better approaches to this area of polymer chemistry are rapidly broadening the spectrum of available materials. Linear polyethylene and isotactic polypropylene are the best known examples of polymers produced by the highly effective coordination-catalyst processes. It was the same type of process that gave us synthetic rubber with a chemical structure identical with that of the natural product."

At Battelle, Palmer's interests encompass studies of polymerization, primarily of the thermoplastics and rubbers, of crystallization and structural problems in polymers, and of the formulation and processing of rubbers. Since rejoining the Institute after military service, he has been associated with and guided diverse research activities. Among developments in which he has had an important role have been a process for improving plastic films, plastic envelopes to make feasible the insulation of appliances with gases, a novel catalyst for controlling the structure of polymers, and an improved polymerization process for preparing a molding polymer. He has also participated in studies relating to the polymerization of fluorine-containing monomers, the protection of rubber against degradation by ozone, and the causes of instability in synthetic rubber latex.

A graduate of Ohio State University with a B.S. degree in chemistry, Palmer pursued graduate studies at the University of Cincinnati and returned to Ohio State for his Ph.D. in physical chemistry.

As an outgrowth of his research activities, he has been author or coauthor of a dozen papers, and his name appears on about 10 patents issued and pending. Palmer is active in the affairs of the American Chemical Society and of its Columbus Section. He is past chairman of the Section, and currently he is serving as one of its representatives to the National Council of ACS.

He spends most of his leisure at home, in family activities. Currently he is participating in the Boy Scout program. Together, Palmer and Esther, his wife, share the interests and problems of Blaine in his university career and of Alan, Philip, and Karen.

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COMMENTARY

Toward a Science of Design

The progress of technology has been marked by varied approaches to the solution of its problems. Since World War II, for example, U.S. technology has better utilized the established scientific and mathematical disciplines in meeting the demands of the cold war and the nation's economic growth. This approach is reflected strongly in our educational institutions where the training of engineers stresses the basic analytical disciplines. Earlier, technology had been dominated by the empirical approach to design and invention. In this, the engineering "artist", with a finely honed intuition, was the master.

Now a new and very effective approach to technological problems is appearing—a development we may identify as an emerging science of design. This new concept is a maturing combination of the rigor of the modern analytical approach and of the judgment and imagination inherent in intuitive engineering. This trend is reflected in engineering curricula where courses are being offered in "creative design". This suggests that the attainment of design judgment is fully as academically challenging as is the mastery of the more conventional technical subjects. The new design courses are based on the recognition that there is never just one analytically provable answer to technical needs—that arriving at the best answer often requires imagining solutions beyond the realm of readily available analytical proof. In this new approach, the search for alternative solutions and the application of enlightened engineering judgment determine the route to a best design.

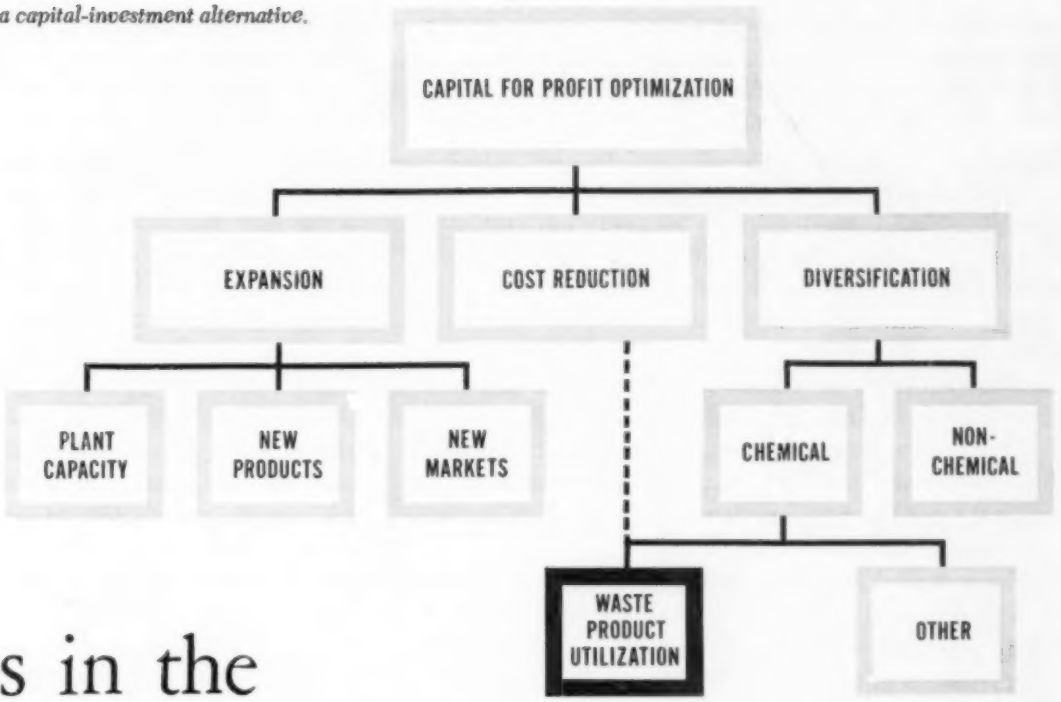
Universities have had courses in design for years, wherein students have been taught the design of gears, bearings, and electronic circuits. But acceptance of the new concept, which is gaining in both industrial and academic circles, is recognition that design is of necessity becoming a science. Moved beyond the environs of the drawing board, design now encompasses the complete research picture from recognition of a technical and economic need to the development of a finished end item. The full range of basic scientific knowledge and the power of analysis have joined imagination and judgment as the principal tools of the designer in conceiving and developing new concepts.

The effects of the science of design are most striking, and the demand for sophisticated design is evident, both in industry and in the national defense activities of government. One result has been the emergence of the systems manager who can grasp the total scope and implications of a design problem and direct an interdisciplinary effort that will result in a creative solution.

In our modern technical society, the process from conception to ultimate use of an idea is complex. And as a key figure in this process, the designer must be aware of, and be capable of finding answers to, the many problems involved. Technically, he must have a clear understanding of the purpose of a concept and of the means by which it can best be brought to fruition. Naturally, he is concerned with materials, form, efficiency, and economy. But he must understand, also, how to satisfy the human needs involved. And, over all, he must be able to envision how the concept can be most effectively converted to reality.

Rollin J. McCrory, assistant manager,
Battelle's department of mechanical engineering

Waste-product utilization as a capital-investment alternative.



Strategies in the Chemical Utilization of Waste Products

Waste products, frequently economic burdens to manufacturers, can sometimes become assets. Here is a discussion of possible strategies in waste-product utilization, with comments on pitfalls and advantages.

by Edward S. Lipinsky *and* Joseph E. Burch

Waste products in industrial manufacturing processes are frequently economic burdens. They may increase costs by reducing the yield of salable products, by necessitating larger equipment, by increasing the amounts of materials that must be processed, or by introducing difficult and costly waste-disposal problems. Nevertheless, waste products can sometimes become assets by chemical conversion to useful materials. Before a company elects to reduce costs in this manner, however, it should carefully weigh the pros and cons of waste product utilization and consider the possible strategies it might pursue.

Investing for Future Returns

Chemical utilization of waste products must be viewed by management as diversification into the chemical industry. This statement is so obvious that its implications are frequently overlooked. Although many companies that are basically raw-material oriented consider waste product utilization to be a means of cost reduction, costs will not be reduced unless the entry into the chemical industry is commercially successful.

Waste product utilization, then, is merely one investment possibility that must be weighed against the company's other investment opportunities. The chart on this page shows several ways in which capital might be invested to improve future profitability of a company. Let us, for example, examine the possible investment routes that might be considered by a manufacturer of frozen fruit juice. The company might use its capital profitably in business expansion. If consumer demand and raw materials supply warrant doing so, a suitable expansion might merely entail increasing production capacity. Under other circumstances, the company might expand its operations to include new frozen juices or beverages. It might also establish processing plants and sales offices in new areas overseas.

The frozen-fruit-juice manufacturer might also use its capital to reduce costs. This may be possible by installing improved processing equipment or by establishing or improving its raw material position through

the purchase of citrus groves. Or the company might find a way to utilize waste citrus peel and pulp.

Avenues for profitable investment of capital might be opened through diversification of the company's operations. In the food field, for example, the production of frozen vegetables, meats, and complete meals, or dehydrated foods might be promising. Diversification into the production of useful chemicals by acquisition or construction of facilities offers another possibility. The company may diversify by undertaking production of materials (such as food additives or fertilizer) useful in its own operation or produce chemicals from its waste products.

Examination of the various investment opportunities open to the company, and their potential returns, will help put the problem of waste-product utilization into perspective.

These remarks are not meant to imply that fewer companies would engage in chemical utilization of waste products if the prospects were compared with opportunities in other areas. Waste product utilization is often profitable and many companies not currently examining this area might find it more attractive than other possible investments. The number of companies upgrading waste products would increase if their alternatives were examined in this light.

Research and Development Strategies

Once waste utilization has been chosen as a field for investment, plans must be formulated to assure an effective program. In the welter of technical and economic details that can ensue, it is easy to overlook simple strategic considerations. Stating the strategy explicitly can be very helpful in translating company goals into technical objectives.

Four general strategies may be employed in the upgrading of waste products for entry into the chemical market. They include manufacturing of:

1. Chemicals that are currently used in large quantities;
2. Accepted specialty chemicals;
3. New chemicals similar to others that have attained high-volume acceptance; or
4. New chemicals not similar to those currently on the market.

Each of these approaches has merits and limitations. If the first two strategies are used, and chemicals that have already found commercial acceptance are produced, customers need only carry out quality evaluations. However, such products would have to meet entrenched competition, and existing markets may be difficult to enter.

The third strategy is effective only if potential customers are willing to alter their product lines or manufacturing procedures. Potential customers will require much more than quality evaluation to determine if the new product is useful to them. In short, they must be induced to spend research and development funds if they are to exploit the product. Established competition must also be met here, but the new product may succeed if it is more satisfactory or less expensive than the chemicals already in use.

The fourth approach, involving a completely new chemical for the market, poses the problem of finding uses for this material. Extensive research, frequently by potential purchasers as well as the supplier, is required. However, if adequate uses can be found, the initial supplier would have the advantage of a head start on competitors, and he could partially amortize his facilities before others could enter the field.

Strategies in Practice

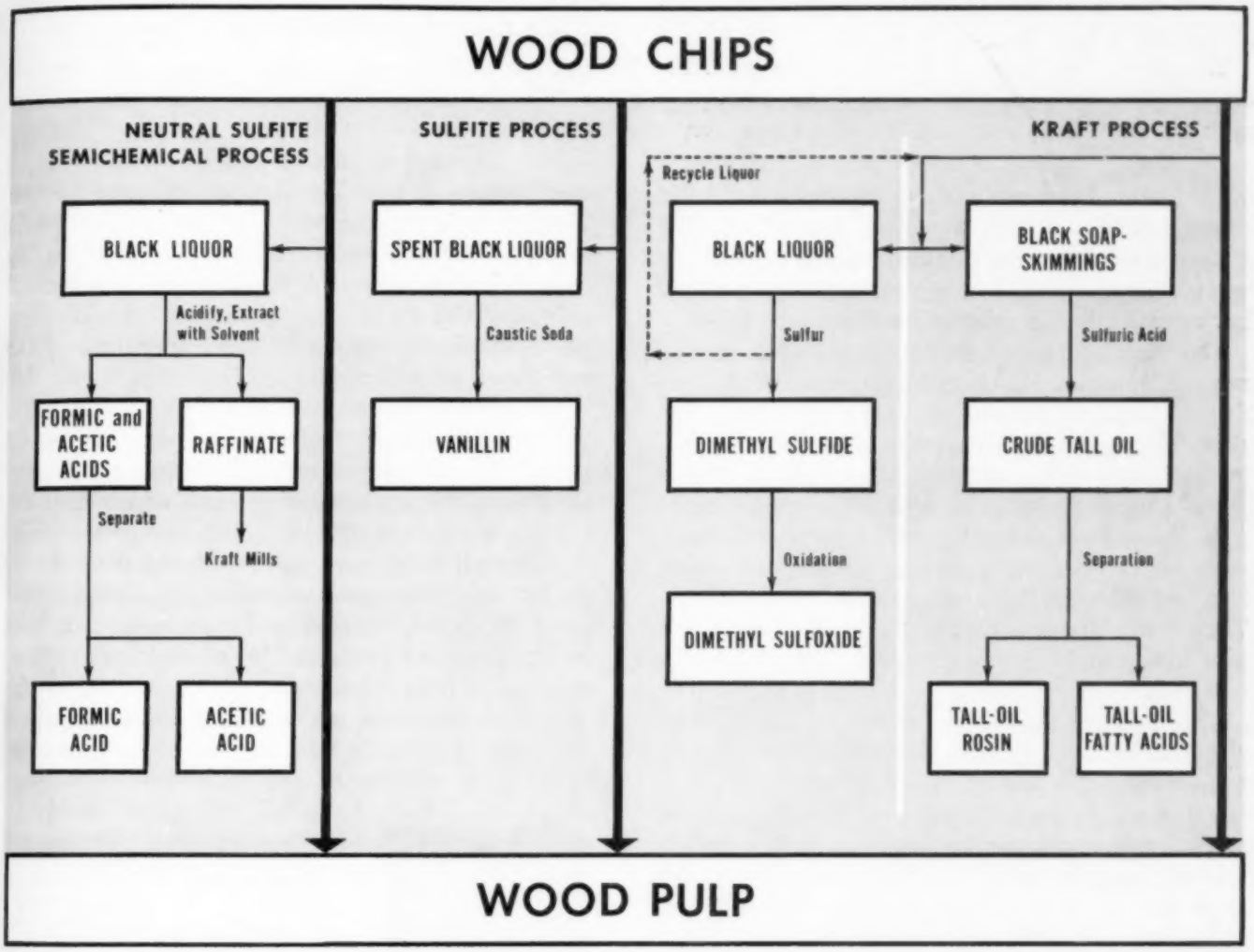
Four case histories, all chosen from the experience of pulp and paper manufacturers, illustrate these approaches to waste product upgrading. The simplified flow chart on page 5 illustrates the processes involved. Similar examples could be found for other waste products. The degree of success for a given strategy in the pulp and paper industry is not necessarily an indication of the potential success of the same approach in another situation. Each case must be judged on its own merits.

Formic and Acetic Acids from Black Liquor — Strategy I

Black liquor from the neutral sulfite semichemical process in pulp manufacture contains both formic and acetic acid, among other chemicals. These acids contribute to stream pollution; hence their removal is desirable. A solvent-extraction process has been developed by one pulp-and-paper manufacturer to recover and refine these acids. The economic problems encountered illustrate well the subtleties involved in duplicating high-volume chemicals that are usually produced by other processes.

The current market for acetic acid is very large—about 650 million pounds per year. However, approximately 80 per cent of the U.S. production is consumed captively, and a new manufacturer is unlikely to gain entry into this segment of the market. Furthermore, the established producers manufacture a variety of

RECOVERY OF SALABLE PRODUCTS FROM PULPING-PROCESS LIQUORS



organic chemicals and solvents and therefore have their marketing costs spread over a large number of items.

Although the current prices of acetic and formic acids appear high when compared with the cost of production from black liquor, the production costs of established producers are not generally known. Proximity to potential customers also plays an important role in the marketing of these acids. Formic acid produced by the new process does not yet meet the specifications established by current producers and accepted by consumers. All in all, what appears at first to be a simple upgrading of a waste product of zero value to one of finite value becomes a complex economic problem requiring detailed investigation.

Duplicating chemicals that are currently sold in large volume to a number of users has two major advantages — little research on applications is needed, and the marketing goal is clearly defined. Research is thus confined to developing an economic process that will yield a product equal or superior in quality to that attained by current producers. The greatest disadvantage is that the competition is strongly entrenched and will not welcome a new producer.

Vanillin from Sulphite Liquor — Strategy II

Although some vanilla flavoring is still extracted from vanilla beans, sulphite waste liquor is the major source of this popular food ingredient. The synthetic product, vanillin, is identical with the chemical constituent of vanilla beans that is the source of vanilla flavor. Vanilla beans are imported and currently cost about $7.00 per pound. In contrast, vanillin costs about $3.00 per pound. Compared with acetic acid, the market is quite small, probably between one and two million pounds per year. This market is not particularly

price sensitive. Vanilla is a relatively minor constituent of food products, and the demand for vanillin is primarily determined by consumer tastes.

The raw-material cost of vanillin is very small because caustic soda and spent sulfite liquor from pulp mills are the starting materials. The yield, however, is under 10 per cent, and expensive processing is required before a pure product is obtained. The basic strategy employed here is to set the selling price sufficiently below that of natural vanilla extract to win customers and to derive a substantial profit from low-volume sale of a relatively high-priced product.

Though a high profit per pound of vanillin is presumably attained, development of new applications that might provide greater profit opportunities is possible. This approach has been tried, and has resulted in development of a polyester fiber that can be produced after several modifications of the vanillin molecule. It has been claimed that this polyester fiber is more elastic than wool but less elastic than nylon, heavier and harder than nylon, and lighter than cotton. Thus, it would appear technically feasible to manufacture from vanillin a product with a very high sales potential.

The economic feasibility of this development is not clear cut, however, because the new fiber would have to compete with a host of natural and synthetic fibers, many of which are made from inexpensive raw materials. Furthermore, the desired chemical intermediate needed for polymerization requires several reaction steps that would contribute considerably to the cost of the polyester. Unless these processing steps are carried out by the vanillin producer, he must sell his product to a chemical manufacturer. The price of this vanillin would have to be far less than the $3.00 per pound currently charged food manufacturers. Indeed, a price as low as $0.25 per pound might be required to induce manufacturers to consider the use of vanillin in polyester production. This reduced price would sharply reduce profits from sale of vanillin to food processors, because while they might be induced to buy a little more vanillin, the added sales would not nearly compensate for the drastically lowered price. After considering economic as well as technical factors, the vanillin manufacturer might well decide to stick with his specialty market and avoid higher volume uses that are only possible at greatly reduced prices.

Tall Oil from Black Soap-Skimmings — Strategy III

In the manufacture of pulp by the kraft process, the black liquor has a scum that can be removed. Acidification of the black soap-skimmings yields tall oil (from the Swedish "Tallolja", meaning oil of pine). This black, evil-smelling oil contains rosin and unsaturated fatty acids contaminated with unsaponifiable matter and dark color bodies. Crude tall oil is an article of commerce. It is useful in ore flotation and other applications that require a low-priced material (about 3 cents per pound) and have undemanding specifications as to color, odor, and other properties. The prices of rosin from wounded trees ("gum rosin") or fatty acids from soybean oil and linseed oil usually exceed 10 cents per pound. It was, therefore, economically desirable to develop processes for separating valuable tall-oil components from impurities and the rosin from the tall-oil fatty acids.

The chemical composition of tall-oil rosin is similar to, but not identical with, that of gum rosin. The major application for gum rosin has been in paper sizing. Relatively little applications research and market development were required to prove tall-oil rosin suitable for this market. The demand for it rose rapidly during the last decade because the production of high-quality paper increased, the supply of gum rosin decreased, and methods for producing tall-oil rosin of excellent quality had been developed.

A much smaller demand existed for rosin-free tall-oil

Edward Lipinsky has been engaged in studies of the upgrading of waste materials and by-products and of the marketability of products. He has participated, at Battelle, in research on the utilization of tallow and animal protein and on modifications of vegetable oils for industrial uses. He has also participated in investigations of potential industrial uses of pharmaceuticals, evaluations of processes for upgrading agricultural products, and the market potentials of tall-oil fatty acids and rosins and of ascorbic acid. Earlier, as research associate in organic chemistry at Ohio State University, he was engaged in the elucidation and synthesis of products of pharmacological interest.

Dr. Burch currently guides chemical economics research at Battelle. Among his areas of concern have been development of uses for new or commercially unexploited chemicals; technical-economic studies of market opportunities for waxes, coatings, chemicals from tar and other sources, products from organic wastes, and chemical services; and technical-economic studies of potential or alternative chemical processing routes. He has conducted studies that have led to the development of characterization tools for oil-type wood preservatives and development of an accelerated method for evaluating the effectiveness of wood preservatives in marine use.

PRODUCTION OF TALL OIL PRODUCTS
(Millions of Pounds)

	1950	1955	1960
Crude Tall Oil	310	584	850
Low-Rosin Tall Oil Fatty Acids	5	47(20%)*	172(6%)*
Rosin	12 (est.)	65	200

*Criteria for "low-rosin" tall-oil fatty acids have been changing rapidly in recent years. In 1955 low-rosin tall-oil fatty acids contained 20 per cent rosin; by 1960 rosin was down to 6 per cent or less.

fatty acids. And because the rosin output could not rise without increasing the output of low-rosin fatty acids, larger markets were needed for the latter. The table above shows the production of crude tall oil, tall-oil rosin, and low-rosin tall-oil fatty acids in 1950, 1955, and 1960.

Relatively impure tall-oil fatty acids had gained established markets in dark-colored surface coatings and in some applications for surface-active agents (e.g., liquid-soap preparations, ore-flotation collectors, and ethoxylated derivatives for detergents). In some of these applications, the presence of rosin was an advantage, and customers were reluctant to purchase purer grades. Prospective purchasers in some fields, where tall-oil fatty acids were not being used, objected to the presence of any rosin in the product. At least part of this objection was based on the dark color that rosin imparted to the fatty acids.

To substantially increase the demand for the rosin-free tall-oil fatty acids, better materials and new uses had to be developed. Research led to better processes so that fatty acids containing under 1 per cent rosin, with greatly improved color, could be produced. As a result, low-rosin fatty acids became important as chemical intermediates, particularly in plasticizers, and as alkyd-resin ingredients of paints and varnishes.

The new alkyd-resin formulations, in contrast with earlier tall-oil-based paint products, were aimed at high-quality applications. Alkyd-resin manufacturers had considerable experience with soybean and linseed oils, and although resins based on tall-oil fatty acids were as good or better than the former, some changes in formulations and processing were required to obtain equivalent products. Thus, in addition to extensive research on these products by the seller, the purchaser had to spend considerable time and money evaluating and adapting these results to his product line. A low, stable price for tall-oil fatty acids served as a powerful inducement for potential customers to undertake such research. Low-rosin tall-oil fatty acids now have a firm position in the paint and varnish market, but much more effort was expended to achieve this position than was required to establish a market for tall-oil rosin.

Dimethyl Sulfoxide from Kraft Black Liquor — Strategy IV

The various pulping processes separate cellulose (pulp) from lignin. Black liquor contains lignin, which is a complex polymer containing methyl groups. Treatment of kraft black liquor with sulfur transfers methyl groups from this polymer to sulfur, producing dimethyl sulfide, a low-boiling liquid with an offensive odor. Indeed, the combination of its smell and volatility have won the compound a portion of the natural-gas odorant market; few other applications have been found. A number of courses are open to dimethyl sulfide producers. Principally, they may find new uses for the compound in its original form or conduct research to find applications in which it may be used as a starting material in the preparation of other chemicals with brighter prospects. The latter course is being emphasized because dimethyl sulfoxide (made from dimethyl sulfide by oxidation) has a number of properties that appear to make it a promising product.

Dimethyl sulfoxide had been commercially available only in limited quantities. Therefore, the construction of full-scale production facilities very closely approaches the strategy of new-product introduction.

Unlike the examples cited earlier, in which the principal markets were more or less evident, a producer of dimethyl sulfoxide is faced with the problem of determining which primary market is likely to be best, and of promoting applications research in that area. Dimethyl sulfoxide has potential uses both as a solvent and as a chemical intermediate. Several basic economic considerations must be taken into account in determining whether to press research efforts on applications for solvents or for intermediates. If dimethyl sulfoxide is to be used as a solvent in chemical processing, the user is likely to recover most of the solvent for reuse. For a given process, then, the potential future market is limited essentially to the make-up of solvent losses. If, however, this powerful solvent can win acceptance in applications where it cannot be recovered, such as solvents for agricultural chemicals or as an ingredient of paint strippers, the effective market may be considerably larger. The use of dimethyl sulfoxide as a chemical intermediate offers the same advantage.

A rather detailed technical-economic investigation would be required before research funds could be properly allocated among the various potential areas for exploitation. Furthermore, the producer of dimethyl sulfoxide must determine which applications should be developed in his own laboratories and which in the laboratories of his potential customers. Other important points to be considered include: size of the

research budget, researchers available, patent situation, state of the art relating to reactions of the compound, technical feasibility and economic promise in the various end-use applications, and amount of information necessary to interest potential customers.

Conclusion

In any program for upgrading waste products, the making or isolating of useful products calls for process research. Applications research, on the other hand, is likely to have a key role in demonstrating the ultimate usefulness of the products. We have seen that little applications research is needed in the duplication of chemicals that are currently on the market; more is needed if an established chemical is to be replaced. On the other hand, if a completely new chemical with no recognized uses is to be introduced to the market, considerable applications research is called for.

If the requirements for applications research are so much greater for new products, why not concentrate on proved products or products very similar to established ones? Although the risks are higher in the introduction of new chemicals, the potential rewards are also greater if adequate markets can be found. The company which introduces a new product does not have to compete directly with established producers and can frequently secure a preferred position with customers. It can also sometimes obtain a strong patent position. Competitors need to enter the field, and meanwhile the innovator may be able to realize a substantial amortization of his investment in research, development, and plant facilities. By the time other companies are ready to compete, the original producer should have substantial advantages in marketing and technical services, and should also have a cost advantage. Thus, originality can pay dividends.

No one approach to the utilization of waste products is necessarily better than another. The technical and economic factors involved must be appraised in each situation before a realistic selection can be made of the approach that seems most appropriate.

WHAT THE SCIENTIFIC REVOLUTION HAS DONE TO SCIENCE

"Three obvious and major phenomena . . . have accompanied . . . [the scientific] revolution. In the first place, science has become complex far beyond the comprehension of any one mind . . . Specialization has made possible the esoteric development of hundreds of lines of thought and research, to the point where acquiring an initial knowledge of any one of them is impossible for all but an infinitesimal proportion of the whole body of citizenry . . .

"In the second place, science has lost its place as a part of the gentle culture and has emerged instead as the partner of technology . . .

"In the third place, a combination of the first two trends has produced a situation in which the guild of qualified scientists is completely unable to man all the posts in society which require an understanding of science . . . Labor leaders, business executives, and stockbrokers are increasingly enmeshed. And most of all, the statesmen and politicians and civil servants find themselves deep in questions of science polity . . . And as a complement of this involvement, the scientists find their affairs less and less the subject of guild determination . . ."

A. Hunter Dupree, in *Science*

Writings by STAFF Members

The following papers are from *Columbium Metallurgy*, v. 10, Interscience Publishers, New York. 1961.

Fabrication of Columbium Alloy Castings at Low Temperatures. Fabrication is discussed in detail; the alloys to which this technique is applicable were predicted. ***J. A. DeMastry and E. L. Foster.*** p. 75-83.

The Fabrication and Mechanical Properties of Some Columbium Alloys for Use in Pressurized Water Reactors. A number of binary and ternary alloys of interest in an alloy development program for pressurized-water reactor applications were prepared, using an electron-beam-refined columbium base, by arc melting and fabricated to sheet. The comparative fabricabilities of these alloys and their hardness, tensile creep, and stress-rupture are discussed. ***D. J. Maykuth and R. I. Jaffee.*** p. 223-256.

The Hot Water Corrosion Resistance of Columbium and Columbium Alloys. Corrosion studies were conducted in 600 and 680 F water and in 750 F steam on a large number of wrought binary and ternary columbium alloys. The corrosion studies were supplemented with metallographic and X-ray diffraction studies. The hot water corrosion resistance of these alloys was correlated with their resistance to oxidation in air at elevated temperatures. ***W. D. Klopp, W. E. Berry, and D. J. Maykuth.*** p. 685-718.

Solid-Phase Bonding of Columbium. Columbium components to be bonded are enclosed in an evacuated envelope or welded to form a gas-tight assembly. The assembly is then subjected to an inert gas pressure and heated above the recrystallization temperature of columbium. The inert gas forces the components into the intimate contact necessary for diffusion to occur. Optimum bonding has been achieved at 1150 C with 10,000 psi of helium gas for a time of 3 hr. ***S. J. Paprocki, E. S. Hodge, and P. J. Gripshover.*** p. 13-30.

The following papers are from *Human Factors*, v. 3, no. 2, July, 1961.

An Evaluation of the Effect of Selected Combinations of Target and Background Coding on Map-Reading Performance—Experiment V. The objective of this study was to determine the relative effectiveness of selected target-background coding combinations. Three target codes were: color, number, and enclosed shape. Five types of background were: all white, solid gray, five shades of gray, five pastel hues, and five different patterns. These target-background coding combinations were evaluated under eight different complexity conditions and for five different operator tasks. The major findings in this study were: no significant differences were found in background coding, numeral coding is superior for the "identifying" task, and color coding is superior for the "locating" and "counting" tasks. ***Charlotte A. Christner and Horace W. Ray.*** p. 131-146.

A Comparison of Vertical and Horizontal Arrangements of Alpha-Numeric Material—Experiment I. The objective of this study was to determine the relative effectiveness of visual displays containing alpha-numeric material displayed in vertical and horizontal arrangements. Variables included in the experimental design were: types of arrangement of display material, density of material, composition of material, and operator tasks. The major finding in the study was the nonsignificance of the arrangement variable. It was found that, for all practical purposes, the differential effects of vertical and horizontal arrangement of alpha-numeric materials on operator performance are negligible. ***John L. Coffey.*** p. 93-98.

An Evaluation of Five Different Abstract Coding Methods—Experiment IV. The purpose of this study was to ascertain the relative effectiveness of selected abstract coding methods, based upon their effects on various operator tasks. Five different coding methods were selected: numerical, letter, geometric shape, color, and configuration. Secondary variables included in the study were target density, number of code levels, and operator tasks. It was found that numeral coding and color coding are the two superior coding methods. If greater emphasis is to be placed on identifying symbols, numeral coding is superior to color coding. No significant differences were found, however, between numeral coding and color coding for the remaining operator tasks: locating, counting, comparing, and verifying. ***William D. Hitt.*** p. 120-130.

Development of Design Criteria for Intelligence Display Formats. A broad research program to develop design criteria for intelligence display formats is outlined and the general findings of the program are discussed. Five specific areas of investigation are selected for study: a comparison of vertical and horizontal arrangements of alpha-numeric material, an evaluation of formats for trend displays, an evaluation of methods for presentation of graphic multiple trends, an evaluation of five abstract coding methods, and an evaluation of the effect of selected combinations of target and background coding on map reading performance. ***W. D. Hitt, H. G. Schutz, C. A. Christner, H. W. Ray, and L. J. Coffey.*** p. 86-92.

An Evaluation of Methods for Presentation of Graphic Multiple Trends—Experiment III. The primary objective of this study was to determine the effect of multiple-line versus multiple-graph presentation of trend-type displays on operator performance. Four types of lines having low confusability were determined experimentally from a sample of twenty-five lines. The primary variable was single-graph, multiple-line presentation versus multiple-graph single-line presentation. Other variables included in this study were: number of lines, degree of confusion among lines, coding of lines, and two operator tasks: point-reading and comparing. It was found that for the point-reading task, either type of display is acceptable, but for the comparing task, the multiple-line display is much superior to the multiple-graph display. Moreover, the use of color coding for the graph lines tended to improve performance slightly. ***Howard G. Schutz.*** p. 108-119.

An Evaluation of Formats for Graphic Trend Displays—Experiment II. This study was designed to determine which of three types of trend formats results in superior performance for a task requiring the subject to make complex decisions. Three commonly used formats were included in the study: line type, vertical-bar type, and horizontal-bar

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In this section are listed reports, articles, and other writings authored by Battelle staff members that have recently become generally available. • *Reports, unless otherwise indicated, can be purchased prepaid directly from the Office of Technical Services, U.S. Department of Commerce (designated OTS), Washington 25, D. C. or from the Publication Board, Library of Congress (designated LC), Washington 25, D. C. Abbreviation "mi" stands for microfilm, "ph" for photostat. The PB and AD numbers or, in the case of the U.S. Atomic Energy Commission Reports, the AEC numbers of each report must be listed with the order.* • *Federal agencies and government contractors, their subcontractors and suppliers may obtain DMIC reports gratis from the Defense Metals Information Center, 505 King Avenue, Columbus 1, Ohio.* • *In most cases, copies of articles and papers listed in this section—but not in the Abstracts Section which follows—are available gratis from the Battelle Publications Office, 505 King Avenue, Columbus 1, Ohio.*

type. Two secondary independent variables were: number of time points and amount of missing data. Results of the study indicate that preference should be given to line-type graphs, followed closely by the vertical-bar type. A secondary finding was that irrelevant points and missing data on graphic trend displays represent important factors in the degradation of operator performance. ***Howard C. Schutz.*** p. 99-107.

Design Information on Titanium Alloys for Aircraft and Missiles. Design allowables are summarized for the commercially important titanium alloys. Information on the all-beta Ti-13V-11Cr-3Al alloy is not yet complete, and little design information is yet available on the super alphas. ***W. P. Achbach and R. J. Favor.*** PB 151104; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Report No. 145*, Jan. 10, 1961, 87 pp. (OTS $2.25)

A Review of the Effects of Starting Material on the Processing and Properties of Tungsten, Molybdenum, Columbium and Tantalum. Summarizes recent information relating characteristics of the as-reduced refractory metal powders to the properties of the consolidated or fabricated product. The history of the powder determines the purity and particle size which in turn affect composition, sintering characteristics, and final purity. The latter can then affect the recrystallization temperature, grain size, strength, and ductility of the fabricated piece. ***B. C. Allen.*** PB 161240; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 90*, March 13, 1961, 40 pp. (OTS $0.50)

Survey of Materials for High-Temperature Bearing and Sliding Applications. Compares thermal, physical, mechanical, and chemical properties of Mo and its alloys with W, Cr, Cb, and Ta; the Fe-, Ni-, and Co-base superalloys; and cermets, ceramics, and graphite. ***M. F. Amateau, D. W. Nicholson, and W. A. Glaeser.*** AD 257408; Battelle Memorial Institute, Defense Metals Information Center. *DMIC Memorandum 106*, May 12, 1961, 67 pp. + appendix. (OTS $2.00)

Theoretical and Experimental Studies Concerning Radiation Damage in Selected Compound Semiconductors. Anomalously low mobilities produced in n-tvpe GaAs as a result of fast-neutron irradiation are interpreted in terms of inhomogenities in the carrier concentration. The very steep temperature dependence of mobility is still a puzzling feature of these irradiations. Annealing of electron-irradiated n-type GeAs can be analyzed in terms of two first-order processes. ***L. W. Aukerman, E. M. Baroody, and R. D. Graft.*** AD 256340; U.S. Air Force, Wright Development Division, May 15, 1961, 16 pp. (OTS $1.60)

Grain-Boundary Diffusion. The diffusion of nickel into grain boundaries of various tilt angles in copper bicrystals was studied. The concentration contours from the grain boundarv and the lateral lattice diffusion were measured by means of electron-probe microanalysis. The product of grain-boundary width and diffusion coefficient were calculated, and comparisons were made with theoretical solutions. The grain-boundary coefficient is concentration dependent above 3% nickel in a 45° tilt boundary. With lower tilt angles, the coefficient is concentration dependent above 0.5% nickel. ***A. E. Austin and N. A. Richard.*** *Journal of Applied Physics*, v. 32, Aug. 1961, p. 1462-1471.

Xenon Diffusion in Single-Crystal and Sintered UO_2. Diffusion was studied by short-time neutron activation and subsequent heating. It was found that diffusion rates in UO_2 single crystals at 1400 C are about two orders of magnitude lower than for sintered UO_2 materials. It is believed that this difference is associated with the presence of fewer defects in the single-crystal materials, probably as a result of the lower metallic-impurity content and greater crystalline perfection. No grain boundary effects were observed for specimens having 2.2- and 23.7- grain sizes. ***Russell H. Barnes, Mihkel Kangilaski, James B. Melehan, and Frank A. Rough.*** U.S. Atomic Energy Commission, *BMI-1533*, Aug. 1, 1961, 40 pp. (OTS $1.00)

Review of Recent Developments in the Technology of Tungsten. Surveys fabrication, properties, structures, and applications. ***V. D. Barth.*** AD 256633; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 108*, May 18, 1961, 6 pp. (OTS $0.50)

Review of Recent Developments in the Technology of Columbium and Tantalum. Briefly reviews major developments in the technology of Cb and Ta, and their alloys, during the period from January through March, 1961. ***E. S. Bartlett and F. F. Schmidt.*** PB 161247; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 97*, April 10, 1961, 6 pp. (OTS $0.50)

Solid State Properties of Non-Conducting Materials of Simple Monatomic and Diatomic Species. Describes work being done on the stability of crystal structure of the heavy rare gas atoms, particularly the effect of many-body forces, including studies of the crystal field in solid argon and the 3-body forces between rare gas atoms which occur in the first order of perturbation theory. Three triangular configurations are considered: an equilateral triangle, a 120 degree configuration, and a linear symmetric array. Preliminary results indicate that for an equilateral triangle the interactions are less repulsive than calculated on the basis of 3 isolated pairs whereas for the linear array they are more repulsive. Battelle Institute, e.V., Frankfurt am Main, Germany. AD 258610; *Special Technical and Scientific Report No. 1*, Jan. 30, 1961, 38 pp. (OTS $4.60)

Thermoelectric Power Generation and Related Phenomena. High temperature electrical and thermal measurements were made on GaAs and alloys of GaS with AlAs. The higher alloys exhibited Hall coefficient-reciprocal temperature relationships similar to those observed for *n*-type GaAs. The thermal diffusivity of GaAs was measured as a function of temperature. The specific heat of GaAs was measured from 0 to 350 C and found to be 0.347 joule/g-deg C. Battelle Memorial Institute. U.S. Navy Bureau of Ships, Washington, D.C. AD 258987; *Bimonthly Report No. 11*, Jan. 18, 1961, 18 pp. (OTS $1.60); AD 258988, *Bimonthly Report No. 12*, March 24, 1961, 30 pp. (OTS $3.60)

Theoretical Study of Homotopy Theory and Duality. Discusses general homotopy groups of spaces and maps; algebraic homotopy theory in abelian categories and in general (non-additive) categories; and group-like structures in general categories. Battelle Institute, e.V., Frankfurt am Main, Germany. AD 255064; April 20, 1961, 12 pp. (OTS $1.50)

The Conception and Preliminary Evaluation of Advanced Cooling Techniques for Ground-Based Electronic Equipment. The present state of the air-conditioning art is reviewed as applied to the cooling of Air Force mobile ground-based electronic equipment. Basic cooling processes are summarized and evaluated for possible application to refrigeration cycles. Recommended cooling processes are applied to thermodynamic-cycle analyses and compared on the basis of power requirements and probable equipment size and weight. ***D. E. Bearint and A. W. Carey, Jr.*** AD 256742; U.S. Air Force, Rome Air Development Center, *RADC-TR-61-79*, March 1961, 92 pp. (OTS $8.60)

Continuous-Tone Electrostatic Electrophotography. Describes work to improve the quality of continuous-tone electrophotographs. A powder-charge-measuring instrument was improved to the point where it can be used routinely as a tool in determining the electrical charge characteristics of powder clouds produced under various conditions. ***W. E. Bixby, R. L. Mitchell, and L. E. Walkup.*** PB 150893; Signal Corps Procurement Agency, Ft. Monmouth, New Jersey. *Quarterly Progress Report No. 1*, Nov. 30, 1955, 33 pp. (OTS $3.60)

Summary of Present Information on Impact Sensitivity of Titanium When Exposed to Various Oxidizers. Summarizes the present status of the compatibility of titanium with LOX (liquid oxygen) and with other oxidizers such as N_2O_4, F_2, and ClF_3. Only in the case of LOX does there appear to be danger that the reaction will propagate and completely consume the titanium. The chance for a reaction can be minimized if the titanium surface in contact with the oxidizer is smooth and surgically clean. ***W. K. Boyd.*** PB 161239; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 89*, March 6, 1961, 9 pp. (OTS $0.50)

The Effect of Nuclear Radiation on Structural Adhesives. Summarizes the radiation stability of adhesives and suggests the areas in which further work is required. The radiation stabilities of various types of adhesives which have been reported are compared, showing the maximum doses at which they may be

expected to give satisfactory service. Tensile-shear data are used primarily for these comparisons because this information has been obtained for the greatest number of adhesives. Bend-test data are also used as a means of comparison where such data are available. ***N. J. Broadway and S. Palinchak.*** AD 256954; Battelle Memorial Institute, Radiation Effects Information Center, *REIC Report No. 17*, March 1, 1961. (OTS $8.10)

Microstructure vs. Corrosion Resistance. Examples are cited of the effect of composition variations and their attendant microstructures on the corrosion resistance of stainless casting alloys, nickel-base casting alloys, wrought zirconium-uranium alloys, and wrought titanium alloys. ***W. K. Boyd and A. M. Hall.*** *Metals Engineering Quarterly*, v. 1, no. 3, Aug. 1961, p. 15-29.

Review of Current Data on the Tensile Properties of Metals at Very Low Temperatures. Reviews current data on the tensile properties of selected metals at temperatures down to −423 F, the temperature of liquid hydrogen. ***J. E. Campbell.*** PB 151107; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Report No. 148*, Feb. 14, 1961, 79 pp. (OTS $2.00)

Review of Recent Developments in the Evaluation of Special Metal Properties. Tensile properties at −423 F are tabulated for a number of alloys. Additional data on the properties of types 301 and 304-L stainless steel sheet cold-reduced 20 to 70% are given for test temperatures of 75, −320, and −423 F. Various phases of the fracture-toughness type specimen for high-strength steel on Ti alloy sheets are being investigated. The presence of a grain-boundary film was reported when type H-11 steel was air quenched. The effects of variations in the composition on the properties of type H-11 were studied. ***J. E. Campbell.*** PB 161244; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 94*, March 28, 1961, 7 pp. (OTS $0.50)

Services, Investigations, and Tests on Standard and Nonstandard Parts and Materials. Methods of testing resistor body enclosures were compared. Film-type resistors from 6 sources were subjected to extensive moisture-resistance tests, lead-strength tests, solder-dip application, temperature cycling, salt-water immersion, lead-strength test followed by salt-water immersion, and static-humidity effects. ***W. E. Chapin.*** AD 258784; Signal Corps Procurement Agency, Ft. Monmouth, New Jersey. *Final Summary Report, Nov. 30, 1960*, 38 pp. (OTS $3.60)

Progress Relating to Civilian Applications During January, February, and March, 1961. Describes status of work being done at Battelle on development of nuclear elements, processing of feed materials, design of components, and characterization and evaluation of nuclear metals and other materials. ***Russell W. Dayton and Clyde R. Tipton, Jr.*** *U.S. Atomic Energy Commission, BMI-1496, BMI-1504*, and *BMI-1509*, Feb. 1, 1961, March 1, 1961, and April 1, 1961, Sections individually paged. (OTS $2.50, $2.50 and $2.25)

Progress Relating to Civilian Applications During May, 1961. Gives status of work being done on reactor materials and components, studies of fuels, general fuel-element development, development of uranium carbide, radioisotope and radiation applications, coated particle fuel materials, problems associated with the recovery of spent reactor fuel elements, and development of fabrication processes for cold bonding of Zircaloy-2 to type 410 stainless steel. ***Russell W. Dayton and Clyde R. Tipton, Jr.*** *U.S. Atomic Energy Commission, BMI-1518* (Del.) June 1, 1961, 96 pp. (OTS $2.25)

Development of Niobium-Uranium Alloys for Elevated-Temperature Fuel Applications. Describes fabrication characteristics, physical and mechanical properties, and corrosion behavior in NaK, Na, and water of niobium-uranium binary alloys containing up to 60 w/o U. ***John A. DeMastry, Donald P. Moak, Seymour G. Epstein, Arthur A. Bauer, and Ronald F. Dickerson.*** U.S. Atomic Energy Commission, *BMI-1536*, Aug. 9, 1961, 64 pp. (OTS $1.75)

High-Temperature Niobium-Base Alloys for Sodium-Cooled Reactors. In work to develop fuel-element cladding material for the EBR-II, binary niobium alloys containing 2.37 w/o chromium, 3.34 w/o zirconium, or 5.21 w/o vanadium and a ternary alloy containing 1.56 w/o zirconium and 1.09 w/o chromium were fabricated by forging at 550 C and rolling to sheet or by rod rolling at 1200 C in a stainless steel can. Tensile tests on the annealed materials at 650, 800, 1000, 1150, and 1315 C indicated that chromium, zirconium, and vanadium are potent strengtheners of niobium. The vanadium alloy exhibited the greatest creep resistance. ***John A. DeMastry, Frederick R. Shober, and Ronald F. Dickerson.*** U.S. Atomic Energy Commission, *BMI-1513*, April 14, 1961, 28 pp. (OTS $0.75)

Binary and Ternary Phase Diagrams of Columbium, Molybdenum, Tantalum, and Tungsten. Contains a compilation and discussion of 93 binary and 68 ternary phase diagrams of the four refractory metals, Cb, Mo, Ta, and W. Included with each diagram is a discussion which lists information on the solubility and crystal structure of intermediate phases. ***J. J. English.*** AD 257739; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Report No. 152*, April 28, 1961, 226 pp. (OTS $3.50)

Effect of Physical Treatments on the Stability of Polyamides. Physical treatment by itself is not sufficient to heat stabilize nylon effectively. The deterioration of an unstabilized piperazine copolymer clearly demonstrates that the filaments are still susceptible to thermally induced oxidation, which occurs primarily in the amorphous regions. However, combining the proper physical treatment (quenching and drawing) with the proper additive results in a major improvement in stability. ***M. M. Epstein and C. W. Hamilton.*** *Modern Plastics*, v. 38, no. 12, Aug. 1961, p. 113 + 6 pages.

Extrusion Cladding With Aluminum. Describes successful application of process using aluminum as the cladding and uranium as the core. ***R. J. Fiorentino, C. J. Slunder, and H. J. Wagner.*** *Modern Metals*, July 1961, p. 38-40.

Physical Metallurgy and Mechanical Properties of Materials: Fatigue of Structural Materials. The current state of knowledge on the fatigue properties of structural materials is reviewed. The progress being made, in the case of metallic alloys, toward relating fatigue damage to the behavior of dislocations in the crystalline lattice is enumerated. The need for more information on the behavior of nonmetallic materials under repeated stressing is emphasized. Methods of studying fatigue, the nature of fatigue, and the extent of laboratory fatigue tests are indicated. It is concluded that present knowledge indicates strongly that fatigue involves very local weaknesses and that design to prevent fatigue will require more detailed consideration than previously has been necessary for design for static strength. ***Horace J. Grover.*** *Journal of the Engineering Mechanics Division, Proceedings of the American Society of Civil Engineers*, v. 86, no. EM 6, Dec. 1960, p. 53-64.

Electropolishing and Chemical Polishing of High-Strength, High-Temperature Metals and Alloys. Physical cleanliness is provided by degreasing in solvent (or vapor), and by soaking or treating electrolytically in aqueous alkaline solutions. Chemical cleanliness is provided by pickling, alkaline descaling, vapor blasting, abrasive blasting, etc. Mechanical cleanliness is provided by electropolishing or chemical polishing. The discussion shows the types of solutions that can be used and gives some formulations and procedures for using them. ***J. A. Gurklis, L. D. McGraw, and C. L. Faust.*** PB 161248; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 98*, April 12, 1961, 15 pp. (OTS $0.50)

A Comparison of the Brittle Behavior of Metallic and Nonmetallic Materials. Discusses basic influences on brittle behavior and compares elastic, plastic deformation, fracture, notch sensitivity, energy absorption, fatigue, and thermal-shock properties of metals, ceramics, and plastics. ***C. T. Hahn and R. I. Jaffee.*** AD 258042; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 107*, May 16, 1961, 33 pp. (OTS $0.50)

Studies, Investigations, and Tests of Standard and Nonstandard Parts and Materials. Task 605. Evaluation of Flux-Cored Solders. To establish the necessity of including flux from cored solders in qualification inspections, activated and nonactivated liquid external fluxes and cored solders con-

for the complicated vacuum-deposited-copper corrosion test using electroplated Cu on ferrotype panels was found. Methods for detecting the presence of the flux additives, metallic salts and maleic anhydride, were established. ***A. J. Haskins and R. M. Evans.*** AD 258726; Signal Corps Procurement Agency, Ft. Monmouth, New Jersey, *Final Report, Jan. 31, 1961,* 34 pp. (OTS $3.00)

Superalloy Forgings. Provides useful data on sizes, shapes, and mechanical properties of several forgeable nickel-base, iron-base, and cobalt-base alloys that have useful service temperatures in the range of 1200 F to 1800 F. It does not cover the more widely used alloys, such as A-286 or Inco 901, but is limited to the newer alloys that have higher useful service-temperature ranges. ***H. J. Henning and F. W. Boulger.*** PB 161236; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 86,* Feb. 10, 1961, 41 pp. (OTS $0.50)

Review of Recent Developments in the Metallurgy of Beryllium. Surveys published data on purification and mechanical and physical properties. ***Webster Hodge.*** AD 256206; Battelle Memorial Institute, Defense Metals Information Center. *DMIC Memorandum 105,* May 10, 1961, 6 pp. (OTS $0.50)

Review of Recent Developments in the Technology of Molybdenum and Molybdenum-Base Alloys. Discusses recent published literature made available to the Defense Metals Information Center. ***J. A. Houck.*** PB 161246; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 96,* April 7, 1961, 4 pp. (OTS $0.50)

Determination of Carbon and Nitrogen in Some Refractory Metals. Carbon is determined conductometrically after combustion, and nitrogen by a Kjeldahl distillation following dissolution of the sample. A suitable ratio of sample to the accelerators, tin and iron, has been established to assure a quantitative determination of carbon in the 5 to 200 parts per million range. Satisfactory conditions for the complete dissolution of the alloys have also been established as a step prior to the determination of nitrogen as ammonia. ***Frank E. Huber, Jr. and Dan L. Chase.*** *Chemist-Analyst,* v. 50, no. 3, Sept. 1961, p. 71.

Evolution of Ultrahigh-Strength, Hardenable Steels for Solid-Propellant Rocket-Motor Cases. Discusses the evolution of the current roster of special steels and shows their relationship to the older, more familiar steels. The evolution is traced from AISI 4130, through AISI 4340 and its modifications, and includes the 5 Cr-Mo-V steels (hot-work die steels). The discussion covers the influence of composition of performance and properties, response to tempering and the effects of tempering, and the differences and similarities among the steels. Also included are comments on such matters as fabrication, welding, heat treating, notch sensitivity, decarburization, high-temperature properties, and the benefits of vacuum melting. ***H. J. Hucek, A. R. Elsea, and A. M. Hall.*** AD 257976; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Report No. 154,* May 25, 1961, 42 pp. (OTS $1.25)

Review of Current Developments in the Metallurgy of High-Strength Steels. Discusses through hardening of AISI4340, properties of commercial ordnance steel and "Rocoloy 270", and effect of a controlled amount of decarburization on the fracture properties of ultrahigh-strength steel. ***H. J. Hucek and A. R. Elsea.*** PB 161250; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 100,* April 20, 1961, 2 pp. (OTS $0.50)

Improved Electrical Alloys—A Key to Improved Electronic Components. Present-day requirements for electronic alloys are becoming more difficult to satisfy using a "cut and try" approach. Consequently, somewhat more erudite methods involving the theoretical concepts of the electronic band structure of metals are being used to a greater extent to orient and direct programs aimed at the development of alloys with particular combinations of electrical and other properties. The application of these procedures may well result in the development of alloys with combinations of properties currently believed to be impossible to achieve. ***C. M. Jackson, J. G. Dunleavy, and A. M. Hall.*** *Proceedings of the Electronic Components Conference,* May 2-4, 1961, p. 36-1—36-15.

Survey of Irradiation Facilities. A survey is presented of irradiation facilities generally available to the Air Force and its contractors. Reactor facilities and gamma facilities are included. ***J. F. Kircher.*** PB 156282; Battelle Memorial Institute, Radiation Effects Information Center, *REIC Report No. 11,* April 30, 1960, 136 pp. (OTS $10.50)

Review of Recent Developments on Oxidation-Resistant Coatings for Refractory Metals. Reviews recent developments in oxidation-resistant protective coatings for the four refractory metals, Cb, Ta, Mo, and W. ***W. D. Klopp.*** AD 255278; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 102,* April 26, 1961, 3 pp. (OTS $0.50)

Studies of Molybdenum-, Tungsten-, and Chromium-Base Alloys With Improved Ductility. A study was conducted on rhenium-free alloys to duplicate, if possible, the beneficial effect of rhenium. Twinning and reduction of interstitial solubilities are promoted by platinum-metal additions, while osmium, tantalum, and columbium changed the nature of the intergranular oxides. Improvements in the fabricability of cast molybdenum also were promoted by platinum-metal additions, particularly by osmium. These additions strengthened molybdenum but also increased the ductile-to-brittle bend transition temperature. ***W. D. Klopp, F. C. Holden, and R. I. Jaffee.*** PB 150249; U.S. Office of Naval Research, Washington, D.C. *Technical Report, Aug. 31, 1960,* 34 pp. (OTS $3.60)

Further Studies on Rhenium Alloying Effects in Molybdenum, Tungsten and Chromium. Improved fabricability is associated with redistribution of the grain-boundary oxide as a complex rhenium-molybdate. The improved ductilities of Mo-35Re and W-30Re are associated with lower interstitial content, enhanced capacity for slip at low temperatures, and associated with low critical stresses for deformation by twinning, which appears to be a function of rhenium content alone. Rhenium also significantly lowers the ductile-to-brittle transition temperature of chromium to below −196 C in bending. ***W. D. Klopp, F. C. Holden, and R. I. Jaffee.*** PB 171908; U.S. Office of Naval Research, Washington, D.C. *Technical Report, July 12, 1960,* 34 pp. (OTS $1.00)

Zinc Coatings for Protection of Columbium From Oxidation at Elevated Temperatures. Zinc coatings may be applied by vacuum distillation at 1450 F, hot dipping at 1000 to 1300 F, aqueous electroplating, or cladding. A conditioning treatment consisting of about 16 hours at 1600 F in air is required to obtain maximum protection at higher temperatures. The service life of a properly conditioned 6-mil coating is about 1000 hours at 1800 F and 70 hours at 2000 F. ***W. D. Klopp and C. A. Krier.*** PB 161238; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 88,* March 3, 1961, 20 pp. (OTS $0.50)

Development of Procedures for Welding 2-Inch-Thick Titanium-Alloy Plate. Describes results of tests made on welds in A-70 and Ti-6Al-4V base plate using A-55 and Ti-5Al-2.5Sn filler wires. ***R. L. Koppenhofer, et al.*** AD 258856, U.S. Bureau of Naval Weapons, Washington 25, D.C. *Bimonthly Report, Feb. 28, 1961,* 18 pp. (OTS $1.60)

The Compatibility of Gas Coolants and Ceramic Materials in Coated-Particle Nuclear Fuels. The compatibility of CO_2, CO, steam, air, nitrogen, and hydrogen coolants with carbon, Al_2O_3, BeO, MgO, Nb_2O_5, SiC, UO_2, ZrC, and ZrO_2 ceramic materials was investigated to 1500 K. Under the test conditions, Al_2O_3 and ZrO_2 are the ceramics most compatible with all coolants. Nitrogen is the gas coolant that appears to be most compatible with the widest variety of ceramic materials. ***Arthur Levy and John F. Foster.*** U.S. Atomic Energy Commission, *BMI-1530,* July 18, 1961, 28 pp. (OTS $0.75)

Fundamental Studies on the Mechanism of Ultrasonic Welding. Previous studies which had shown the effects of time, temperature, and clamping force on ultrasonic welds were expanded to include studies of the shear force during welding. The findings indicate that ultrasonic welding is not suitable for

the production of aircraft-quality spot welds in heat-resistant and dissimilar metal combinations. As a material's hardness increases, and the ratio of tensile strength to yield strength decreases, weldability by the ultrasonic process decreases. ***W. J. Lewis, et al.*** AD 257733; U.S. Air Force, Wright Air Development Division. *Report for March-July 1959, on Metallic Materials,* Dec. 1960, 44 pp. (OTS $1.50)

Flux and Filler-Wire Developments for Submerged-Arc Welding HY-80 Steel. A new flux and filler wire were developed for submerged-arc welding submarine hulls. The flux raises weld metal impact properties while lowering oxygen and inclusion contents; the new filler wire produces weld metal with notch toughness over 40 ft-lb at −80 F in both as-welded and stress-relieved states. ***W. J. Lewis, G. E. Faulkner, and P. J. Rieppel.*** *Welding Journal,* v. 40, Aug. 1961, p. 337s-345s.

Thermoelectric Properties of Bi_2Te_3 and Some Bi_2Te_3 Alloys. Describes fabrication, properties, and structure of Bi_2Te_3 and its alloys with Bi_2Se_3 and Sb_2Te_3. ***E. H. Lougher.*** Paper from *Thermoelectric Materials and Devices,* p. 133-142, 1960. Reinhold Publishing Corp., New York.

Physical Metallurgy of Nickel-Base Superalloys. Discusses strengthening mechanisms, heat treatment, and evolutionary history. Solid-solution hardening, precipitation hardening, strengthening by boron and zirconium additions, and failures are considered. Also outlines the progress and describes the attitude of alloy development by British, U.S., and Soviet investigators during the years 1946-1960. Chemical compositions and mechanical properties are tabulated for 30 selected British, U.S., and Soviet alloys. ***C. H. Lund.*** AD 258041; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Report No. 153,* May 5, 1961, 40 pp. (OTS $1.25)

Strengthening Mechanisms in Nickel-Base High-Temperature Alloys. Reviews the various mechanisms from which these materials derive their high-temperature strength. The strengthening mechanisms discussed are solid-solution hardening, precipitation hardening, and strengthening imparted by additions of boron and zirconium. ***C. H. Lund and D. C. Drennen.*** PB 161245; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 95,* April 4, 1961, 19 pp. (OTS $0.50)

A Statistical Summary of Mechanical-Property Data for Titanium Alloys. Describes in a series of histograms and charts some mechanical properties of several titanium alloys in various conditions and directions in terms of average values and standard deviations. The alloys described were produced and tested in the period from 1957 into 1960. ***W. Stuart Lyman.*** PB 161237; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 87,* Feb. 14, 1961, 25 pp. (OTS $0.50)

Estimation of the Parameters of a General Class of Failure Processes With Particular Reference to the Weibull Process. A methodology is developed for the estimation of the parameters of a general class of failure processes from experimental data. The class of failure processes consists of those in which the dependence relation between time and the conditional density function of failure probability is such that known functions of each of the two variables exist which are linearly related to each other. ***Arthur E. Mace.*** PB 149439; U. S. Office of Naval Research, *NRL-TR-1,* July 1960, 31 pp. (OTS $3.60)

How Should You Evaluate High-Strength Materials? Discusses the challenge to the engineer to find stronger and lighter structures. There are subtle differences in high-strength metals which the usual evaluation tests will not disclose. These materials can be rated on the basis of their load-carrying ability (net section strength) in the presence of the stress raiser that seems appropriate. ***G. K. Manning.*** *Metal Progress,* v. 80, no. 3, Sept. 1961, p. 65-67.

Development of New or Improved Techniques for the Production of Tungsten Sheet. A State-of-the-Art-Survey. Two consolidation techniques should be initially followed: arc melting or powder metallurgy. For the arc-cast work pure tungsten is recommended as the alloy, while for the powder metallurgy work K-100 powder is recommended. The arc-cast material should be extruded and then forged or rolled directly. Preliminary data indicate that direct forging can be accomplished and should be investigated. ***D. J. Maykuth, V. D. Barth, and H. R. Ogden.*** AD 258137; U.S. Air Force, Air Material Command, Aeronautical Systems Center, Wright Patterson Air Force Base, Ohio. Bound with *Tungsten Sheet Rolling Program,* Dec. 29, 1960, 102 pp. (OTS $9.60)

Application of Tantalum in Electronic Design. Discusses properties, effects of fabrication on design parameters, current design applications, and proposed development design uses. ***Daniel J. Maykuth.*** *Electro-Technology,* June 1961, p. 129-132.

An Automatic Process for Welding Girth Joints in Steel Pipelines. Describes process involving CO_2-shielded consumable-electrode arc welding used in a fixed horizontal position. The method is characterized by excellent weld quality, high welding speeds, and elimination of weld backing rings. ***J. W. Nelson, G. E. Faulkner, P. J. Rieppel, and H. C. Cook.*** *Welding Journal,* v. 40, Aug 1.961, p. 813-820.

The Development of a Photomemory. The demonstration reading system of the photomemory performed reliably on 0.006 in wide bits over a limited plate area. Slight improvements in the illumination system will enable the demonstration reader to perform reliably on a 2 x 2 in. data plate containing 0.004-in. wide bits. The results thus far indicate that the ultimate desire to read a 4 x 4 in. plate containing 0.001 x 0.004 bits is feasible. A prototype photomemory is anticipated as a result of further developments. A reading system utilizing a larger plate and smaller bits as well as a preliminary writing system will be incorporated in the prototype. ***Carl E. Nielsen, Jr.*** PB 156875; U.S. Office of Naval Research, Washington, D.C. *Annual Summary Report No. 2,* Aug. 15, 1959-Aug. 15, 1960, 31 pp. (OTS $3.60)

Statistical Analysis of Tensile Properties of Heat-Treated Mo-0.5Ti Sheet. Direction of testing affects all five tensile properties; ultimate and yield strength are higher in the transverse direction, while elongation is higher in the longitudinal direction. Gage has little effect on ultimate or yield strength, but an increase in gage causes a pronounced increase in elongation. Direction of testing does not interact with gage effect, the effect of gage on all five tensile properties is about the same in both the longitudinal and transverse directions. ***H. R. Ogden and G. H. Beatty.*** AD 255456; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 101,* April 24, 1961, 18 pp. (OTS $0.50)

A Review of Bending Methods for Stainless Steel Tubing. Describes the applications and limitations of ram bending, roll bending, rotary compression bending, and rotary draw bending. Large-diameter, thin-wall tubing may be bent without buckling to a 2D minimum bend radius using draw bending and conventional but modified bending tools. Proper lubricants must be applied generously at strategic areas to avoid galling and scoring. Once bending is started it must proceed to completion without stopping. ***C. T. Olofson.*** PB 151109; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Report No. 150.* March 2, 1961, 56 pp. (OTS $1.50)

Incorporation of a Boron Burnable Poison and Spherical UO_2 in SM-2 Stainless-Matrix Fuel Plates. An improved fuel plate containing 26 w/o UO_2 dispersed with ZrB_2 in a low-cobalt low-tantalum Type 347 stainless steel matrix was developed as a reference design for the SM-2 reactor. Design conditions include a maximum center-line temperature of 684 F, an average heat flux of 1.65×10^5 Btu/(hr)(ft^2), and an average burnup of 39% of the uranium-235. ***Stan J. Paprocki, Donald L. Keller, George W. Cunningham, and Andrew K. Foulds.*** U.S. Atomic Energy Commission, *BMI-1527,* July 6, 1961, 50 pp. (OTS $1.25)

Fabrication and Irradiation of SM-2 Core Materials. Irradiation and examination have been completed on four capsules of specimens prepared in the SM-2 Core Materials Development Program. Each capsule contained five to eight flat-plate dispersion specimens roll clad with Type 347 stainless steel. The capsules underwent burnups of 20 to 40 a/o of the uranium-235 at surface temperatures near 700 F. It was found that the burnable poisons, both dispersed in the fuel and alloyed in the cladding, performed satisfactorily. ***Stan J. Paprocki, Ronald***

F. Dickerson, George W. Cunningham, William E. Murr, and Donald E. Lozier. U.S. Atomic Energy Commission, *BMI-1528*, July 12, 1961, 45 pp. (OTS $1.25)

Brazing for High-Temperature Service. Summarizes many of the important developments in brazing for service temperatures in excess of 600 F. Heating methods, filler metals, atmospheres, fluxes, and deoxidizing agents are discussed as they affect the brazing of heat-resistant metals and alloys. Some attention is given to specific brazing applications. ***H. E. Pattee and R. M. Evans.*** PB 151108; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Report No. 149*, Feb. 21, 1961, 32 pp. (OTS $1.00)

An Investigation and Evaluation of Various Core Configurations and Materials for Optimum Transformer Design. Core-loss tests at temperatures from about 80 F to 1381 F were made on four EI laminated cores. The core loss was found to decrease as much as 60 per cent from room temperature to 1000 F. Two-mil, four-mil, and fourteen-mil oriented silicon-iron Epstein samples were tested at frequencies of 60, 100, and 200 cycles per second. The percentage rise of core loss at 10,000 gauss from 60 to 200 cycles per second was approximately 1.7 times greater for the fourteen-mil sample than for the two-mil sample. The larger the number of laminations in a group the greater was the core loss. ***C. F. Rains, et al.*** PB 154974; Signal Corps Procurement Agency, Ft. Monmouth, New Jersey, *Quarterly Report No. 4* April 1, 1950, 61 pp. (OTS $6.60)

Quartzite in Ramming Mixtures for Induction Furnace Linings. Ramming mixtures are used in induction furnaces because a monolithic crucible is needed. Quartzite ramming mixtures are preferred because there is no shrinkage of formation of cracks even during sintering. The quartzite used must remain compact and stable during transformation. The sintering agent must cause the grains of the ramming mixture to bond together, and the surface of reaction to contract. Careful drying of the ramming mixture is necessary before heating. (*In German.*) Quarzit in Induktionsofenstampfmassen. ***Rudolf Rasch.*** *Giesserei*, v. 48, no. 16, Aug. 10, 1961, p. 457–461.

Review of Recent Developments in the Technology of High-Strength Stainless Steels. Research and development in the field of high-strength stainless steels appears to be directed along two principal paths: the development of alloys with improved strength properties and the accumulation of information on the properties and physical metallurgy of existing alloys so that they may be used more effectively. By and large, the development of new alloys is being carried out by the stainless-steel producers, while the accumulation of property data for the most part is being undertaken on Government contracts. ***D. A. Roberts.*** PB 161249; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 99*, April 14, 1961, 3 pp. (OTS $0.50)

Review of Recent Developments in the Technology of Nickel-Base and Cobalt-Base Alloys. Summarizes recent significant developments in the field of nickel-base and cobalt-base alloys and high-strength superalloys. The information was obtained from data made available to the Defense Metals Information Center during the period Jan. 1 through April 28, 1961. ***D. A. Roberts.*** AD 253659; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 104*, May 5, 1961, 4 pp. (OTS $0.50)

Investigation of Feasibility of Utilizing Available Heat-Resistant Materials for Hypersonic Leading-Edge Applications. Volume VI. Determination and Design Application of Mechanical Properties of Bare and Coated Graphite. The mechanical properties of siliconized grade ATJ graphite were studied as functions of temperature (to 2950 F), strain rate, size, and stress state. Supplementary studies were conducted to determine the room-temperature properties of the uncoated material and the degree of anisotropy of both the coated and uncoated material. With proper selection of material quality, the siliconized Grade ATJ graphite may be used effectively as a structural component at elevated temperature in an oxidizing atmosphere. ***Alfred Rudnick, Robert L. Carlson, and George K. Manning.*** AD 257731; U.S. Air Force, Wright Development Division. *Report for Dec. 58 - May 60 on Ceramic and Cermet Materials, and Construction Techniques and Application of New Materials*, Nov. 1960, 213 pp. (OTS $15.00)

Glass Fiber for Solid-Propellant Rocket-Motor Cases. Continuous fibers have been produced from glass with considerably higher tensile strength-to-weight ratios than have been produced from metals. Glass-reinforced plastics also may have a marked cost advantage over metals. The present generation of rocket-motor cases is being made with fibers of Type E commercial glass. This type is used because of its relative ease of manufacture, high resistance to weathering, good strength, and low cost. The full potential of glass fibers can be realized only by the design of systems and structures based on the particular properties of glass fiber. ***R. J. Runck and B. W. King.*** AD 258862; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum* 110, June 6, 1961, 21 pp. (OTS $0.75)

Progress in Electroplating in the U.S.A. Improvement in the protective effects of decorative coatings for external parts is the most important development in electroplating in the U.S. during recent years. Increase of the Ni protective layer thickness from 20 μm to 30 μm was obtained for external parts of automobiles. The greatest progress consists in the use of duplex-Ni layers instead of polished sheet Ni, and in the increase of the Cr layer thickness up to 0.75 μm. Thus the Cr layers are three times as thick as those deposited in 1958. These thicker Cr coatings can be free from cracks and microfissures. The durability of the electroplated part is tripled. The new Ni and Cr plating methods have been used for only five and three years respectively; nevertheless about 75% of the electroplating plants treating external parts for automobiles work more or less on the basis of the new processes. (*In German*) Fortschritte der Galvanotechnik in den USA. ***W. H. Safranek and C. L. Faust.*** *Metall*, v. 15, June, 1961, pp. 539-542.

Tips for Better Electroplating. Stresses the following check points for plating jobs: properties of the basis metal; surface properties of the basis metal (independent of the rest of the metal); properties of the diffusion alloy of the basis metal and the deposited metal alloy (if it's a high temperature use); and properties of the deposited coating. ***William H. Safranek, C. L. Faust, John G. Beach, and Glenn R. Schaer.*** *Steel*, v. 149, July 31, 1961, p. 56-58.

Decomposition of Pyritized Carbonaceous Shale to Halotrichite and Melanterite. Describes results of examination of a white efflorescence of acicular crystals occurring on shale specimens exposed to room air for about 16 months. ***Charles B. Sclar.*** *American Mineralogist*, v. 46, May-June 1961, p. 754-756.

Tantalum Alloys for Elevated-Temperature Service. Early results of a tantalum alloy-development program have shown that high-hot-strength properties can be attained while maintaining low-temperature toughness and ductility. ***F. F. Schmidt, D. J. Maykuth, and H. R. Ogden.*** *Journal of Metals*, v. 13, July, 1961, pp. 487-489.

Indium Antimonide for Semiconductor-Device Feasibility Studies. Describes progress in preparation of high-purity InSb, design of a magnetoresistance voltage regulator for use as a tunnel-diode bias source, the making of InSb-film depositions on various substances, junction-device studies, and tunnel-diode fabrication procedures. ***T. S. Shilliday, F. J. Reid, et al.*** AD 255986; U. S. Air Force, Wright Development Division, *Scientific Report*, 6, April, 1961, 18 pp. (OTS $1.60)

Environmental and Metallurgical Factors of Stress-Corrosion Cracking in High-Strength Steels. Theories of stress-corrosion cracking are discussed. It is generally agreed that an electrochemical step is involved, in which anodic areas are dissolved away. However, because stress-corrosion cracking occurs only in certain environments which are specific to each metal, the phenomenon is not a general characteristic of electrolytes. The philosophy of laboratory investigation of stress-corrosion cracking is commented upon. Because they are used at high stress, the high-strength steels employed in aircraft and missiles are susceptible to stress-corrosion cracking. ***C. J. Slunder and W. K. Boyd.*** PB 151110; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Report No. 151*, April 14, 1961, 21 pp. (OTS $0.75)

Dynamics of Ionized Gases. The dynamics of a classical, ionized gas is presented in a way which stresses the role of individual particles in contributing to the gross behavior of the gas. An important distinction is drawn between a weakly ionized and a strongly ionized gas, and it is shown how the latter, through long-range interaction forces, exhibits the phenomenon of collective behavior. Three methods of description employed in the study of ionized gases are reviewed. These are the microscopic theory, the velocity-distribution method, and the macroscopic theory. ***Bernard Steginsky.*** *American Journal of Physics,* v. 29, no. 9, Sept. 1961, p. 605-616.

Corrosion of Thorium and Uranium Under Storage Conditions. Thorium, uranium, and uranium-10 w/o molybdenum-alloy specimens in the form of bare and organic- or metal-coated single coupons and composite assemblies joined by soldering, welding, or the use of machine screws, were evaluated for corrosion resistance in accelerated and long-term tests providing exposure to ambient, humidity, salt-spray, and humidity-freezing conditions. The uranium-10 w/o molybdenum alloy was most durable. The vinyl-type organic coatings blistered during the exposures, particularly when applied to uranium. Aluminum coatings on uranium behaved similarly. Nickel coatings plated on thorium showed excellent resistance, however. ***Elmer F. Stephan, Paul D. Miller, and Frederick W. Fink.*** U.S. Atomic Energy Commission, *BMI-1507,* March 21, 1961, 25pp. (OTS $0.75)

Development of Dilute Plutonium Alloys. Plutonium is being studied as a substitute fuel for U-235 in alloys for high-temperature use and for "spike" elements in power reactors. Alloys being studied include Nb-Pu, Nb-Pi-Si, Nb-Pu-Zr, Th-Pu, and Th-Pu-Zr. ***Victor W. Storhok, Arthur A. Bauer, and Ronald F. Dickerson.*** U.S. Atomic Energy Commission, *BMI-1532,* July 27, 1961, 24 pp. (OTS $0.75)

Engineering Intuition. Engineering is the area of interaction between science and society. Without the engineering that we take so much for granted, Western civilization would cease to exist for most of the people living under its protection. The engineer and the architect will have to carry the principal task in solving present and future problems involved in improving the living conditions of the world's growing population. ***B. D. Thomas.*** *News in Engineering,* v. 33, July 1961, p. 13-16.

The Effect of Various Levels of Automation on Human Operators' Performance in Man-Machine Systems. Describes a method for generating definitive data on the effects of automation on human operators' performance. The method incorporates a model and equipment for theoretical and experimental investigations. Pilot experiments have demonstrated that the model adequately describes automation problems. Significant effects of various levels of automation were demonstrated in some of the experiments. ***Ralph E. Thomas, et al.*** PB 171290; U.S. Air Force, Wright Air Development Division, *WADD Technical Report 60-618,* Feb. 1961, 157 pp. (OTS $2.00)

A Radiochemical Technique for the Determination of Short-Lived Fission Gases. Describes method for determining release rates of gases from fuel specimens during irradiation by the collection and analysis of the solid daughter products of these gases. The gases are swept through a long tube packed with stainless steel mesh, and the daughter products deposit on the mesh as they are formed. The mesh is analyzed radiochemically for the daughter species, strontium-89, cesium-137, barium-140, and cerium-141. From the results of these analyses, the release rates of the parent fission gases may be calculated. ***Charles W. Townley, James E. Howes, Jr., Gilbert E. Raines, Ward S. Diethorn, and Duane N. Sunderman.*** *Nuclear Science and Engineering,* v. 10, Aug. 1961, p. 346-351.

Strengthening of Iron-Base Alloys Containing Columbium. Columbium, C, and Ni additions were made to Fe-base alloys with 20% Cr. The effects on microstructure, precipitation-hardening characteristics, and high-temperature properties were investigated by means of metallographic, hot-hardness, and magnetic measurements. An austenitic alloy consisting of Fe-20Cr-14Ni-0.8C-2.5Cb had higher hot-hardness at 1700 F than the other alloys investigated. Its favorable standing is attributed to an enhanced interaction of Cb and Cr_4C particles dispersed within a stable austenitic matrix. ***E. E. Underwood, E. M. Stein, and G. K. Manning.*** American Institute of Mining, Metallurgical and Petroleum Engineers, *Transactions, Metallurgical Society,* v. 221, no. 4, Aug. 1961, p. 676-682.

Quantitative Metallography. Discusses advantages of three-dimensional parameters to characterize behavior of alloys. Describes quantitative measurement of volume fraction of some or all the constituents of an alloy by areal analysis, lineal analysis, and point counting. Gives exact and approximate methods for determining the boundary area of grains, phases, and other structural components. ***Ervin E. Underwood.*** *Metals Engineering Quarterly,* v. 1, no. 3, Aug. 1961, p. 70-81.

Ozonation of Butyl Rubber to Estimate Unsaturation. A method was developed for the estimation of the unsaturation of butyl rubber by ozonation in selected solvents. Under a given set of conditions the ozonation method is reproducible to within 7% and conceivably could be improved by further refinement. The unsaturation of a butyl rubber can be estimated in about 10 min. when using ozonated oxygen and in about 15 min. when using ozonated air. ***I. S. Ungar and G. A. Lutz.*** *Rubber Chemistry and Technology,* v. 34, no. 1, Jan.-March 1961, p. 205-210.

A Study of Radiation-Induced Changes in Polymers Leading To Graft Copolymerization as Influenced by Structural Factors. Describes the preparation, irradiation, and grafting of a number of polymethacrylates. A mechanism of radiation attack on the polymers is proposed. Free-radical measurements, the quantitative determination of the volatile products of irradiation, and chemical analysis of the grafted copolymer were used in establishing this mechanism. ***Israel S. Ungar, John F. Kircher, William B. Gager, Francis A. Sliemers, Jr., and Robert I. Leininger.*** U.S. Atomic Energy Commission, *BMI-1511,* April 3, 1961, 28 pp. (OTS $0.75)

Standard Designations of Alloys for Aircraft and Missiles. Tabulates trade names, aeronautical and military specifications, and producers of stainless steels, alloy steels, and superalloys. ***J. J. Vagi and A. F. Haskins.*** PB 161192R; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 42R,* May 24, 1961, 78 pp. (OTS $0.50)

Review of Recent Developments in Metals Joining. Surveys current literature in the fields of mechanical joining and welding of refractory metals. The processes mentioned include flash welding, brazing, spot welding, electron beam welding, and adhesive bonding. ***J. J. Vagi, H. E. Pattee, et al.*** AD 256852; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 109,* May 25, 1961, 5 pp. (OTS $0.50)

Thermodynamics of Boron Loss in UO_2-Stainless Steel Dispersion Fuel Elements. By means of calculating the standard free-energy reaction, 108 of 500 postulated reactions were evaluated quantitatively. The standard free energies of formation of the compounds of interest were compiled from the literature, or were either calculated or estimated. In the case of ZrB_2, the standard free-energy value was confirmed by experiments. ***J. J. Ward, C. A. Alexander, A. W. Lemmon, Jr. and R. B. Filbert, Jr.*** U.S. Atomic Energy Commission, *BMI-1531,* July 18, 1961, 20 pp. (OTS $0.50)

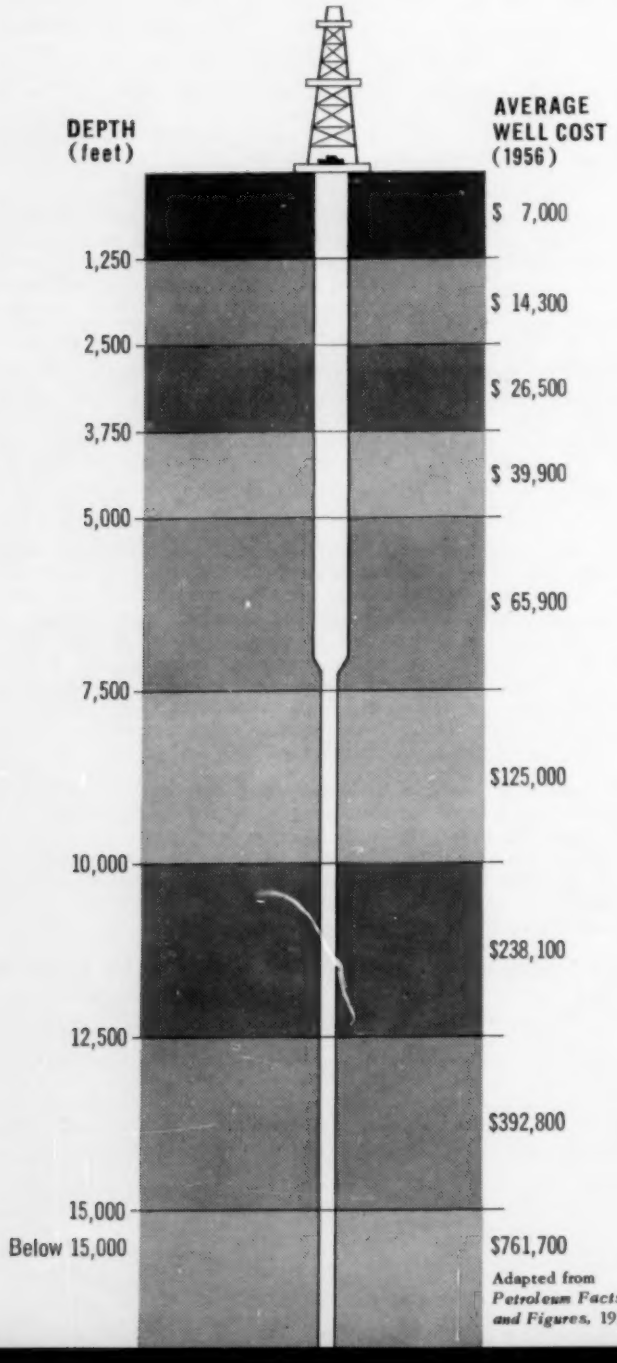
Ultrasonic Welding of Heat-Resisting Metals. Ultrasonic spot welding of various combinations of heat-resisting alloys was studied. Room-temperature tension-shear and cross-tension strengths were obtained for each combination. Only the welds in Ti and between stainless steel, Fe and Cb appeared to have acceptable cross-tension strengths. ***N. E. Weare and R. E. Monroe.*** *Welding Journal,* v. 40, Aug. 1961, p. 351s-358s.

The Emittance of Coated Materials Suitable for Elevated-Temperature Use. Compiles original test data taken from the literature published during the period 1940 to 1949, inclusive, and from as much of the 1960 literature as could be obtained. Covers boride, carbide, oxide, and silicide coatings and enamels and paints. ***W. D. Wood, H. W. Deem, and C. F. Lucks.*** AD 256479; Battelle Memorial Institute, Defense Metals Information Center, *DMIC Memorandum 103,* May 4, 1961, 138 pp. (OTS $2.75)

New Directions in Petroleum Exploration and Production

by FRANK C. CROXTON

While U.S. petroleum needs rise, reserves in terms of probable future demands are dropping. Only better exploration, production, and conservation methods can maintain an adequate petroleum supply.



Adapted from *Petroleum Facts and Figures*, 1959

IT HAS NOT BEEN GIVEN to previous generations to see an area of technology born, develop to maturity, and then experience a substantial evolution, all during a human lifetime. Such has been our privilege, however, in observing and benefiting from the petroleum industry.

The centenary of the discovery of oil in Venango County, Pennsylvania, has only recently been commemorated. About half of the interim since bringing in the discovery well was devoted primarily to the production of medicinals and lamp oil. Only since the inception of mass production of the automobile has the petroleum world's major product been gasoline. Annual production figures of 110,000,000 tons of steel or 500,000,000 tons of coal are well known. Few realize, however, that 9,000,000 barrels per day of petroleum products in the United States represents 500,000,000 tons annually. Of this, almost 250,000,000 tons is gasoline.

During recent years, the petroleum industry of the United States has been conducting research at a rate of about 0.8 per cent of its sales. This means a minimum annual research effort of $275,000,000—minimum because additional petroleum research is conducted by organizations outside the petroleum industry.

Of this total, only a fraction is devoted to research in the fields of exploration, development, and production of petroleum. Yet over the years, there have been constant advances in these areas. In spite of the leaping consumption of petroleum, the industry has been able to retain a sizeable reserve within the United States. The industry's research, along with discoveries in various disciplines, have made available new, even revolutionary techniques that promise solutions of the difficult problems now arising. What follows is a brief review of techniques used in the past and a consideration of emergent problems and techniques for their solution.

EXPLORATION AND DEVELOPMENT

Over a period of time, but not necessarily just as this is being written, strong pressure is on producing firms and the producing branches of integrated companies to find more oil. Currently, proved reserves in the United States correspond to only about 12 years' consumption of crude *at the present rate*. They amount

to only 7 years' consumption at the 1975 rate predicted by The President's Materials Policy Commission. Worldwide annual consumption, however, is only 1/40 of the world's proved reserves. Either nationally or globally, there is a strong incentive to add to proved reserves both to encourage investment in refining, transportation and marketing facilities, and to make possible the growth of the annual rate of production which must always be a minor percentage of the reserves. Accordingly, exploration for crude continues at a great rate, using the most powerful available tools while the industry seeks still more powerful ones. Better methods of exploration are especially important in the United States, which supplies more than 80 per cent of such venture funds for the world. This country, which has 11.2 per cent of Free World reserves, completed 58,000 wells in 1956 alone. On the other hand, Kuwait's reserves, constituting 22 per cent of those of the Free World, have been developed with a total of only 300 wells.

In the earliest days of really active exploration, one looked for seepages of oily material much as prospectors sometimes look for outcrops of especially desirable ores. Seepages demonstrated the actual existence of crude oil. When fewer and fewer seepages remained to be found, other methods of exploration became necessary to guide the drillers and producers who were trying to satisfy the world's demand for so-called "rock oil." From about the beginning of this century, we have been depending on methods which imply the presence of oil. Really, they locate geological structures with which oil is often associated.

Location of world's important oil reserves in 1958. Reserves (in billions of barrels) and proportion of reserves are given for each area.

First, there was surface geology which pointed to faulted structures and possibly trapped oil. As Hodges and Steele have pointed out, this method was used to such an extent by 1912 that an unusually high value of reserves found per new-well completion occurred in that year. By 1924, surface geology had done its job in the comparatively easy Rocky Mountain areas and in California and was applicable only with difficulty elsewhere.

In the meantime, the torsion-balance came into use for the location of salt domes, another structure which enabled oil to concentrate while, at the same time, preventing its outward leakage and dissipation. During the 1922-1932 period, a number of domes and, accordingly substantial crude reserves, were discovered.

Seismic surveying by the refraction method overlapped the foregoing somewhat but did not reach its maximum of effectiveness until about 1937. The method covered a longer period, but it did not fully mature until 1948. Meanwhile, the gravimeter was replacing the torsion balance, producing its greatest effect in the years around 1945.

Hodges and Steele summarize these numerous developments of exploration into three phases: (1) surface geological methods, (2) extensive geophysical methods, and (3) intensive geophysical methods. The maximum reserves found per new-well completion occurred in the middle 1940's. Since then, this important figure, which reached 90,000 barrels, has been declining. There is little doubt that the absence of a new and better exploration development since the end of World War II is responsible. Needless to say, many investigations are in progress now and are indicative of the exploration research of the future. A number of these studies deal with procedures which are referred to more or less accurately as direct oil-detection methods. Except for gas surveying, however, all seem to deal again with phenomena often associated with petroleum deposits. The following is a brief review, based partially on a paper by V. A. Sokolov et al. at the Fifth World Petroleum Congress, in New York, in May, 1959.

Sensitive Analytical Methods

An oil-gas deposit consists of an enormous variety of hydrocarbons, from those of very high molecular weight usually down to methane itself. Methane and a few of its homologues are, of course, the most fugitive, thus tending to migrate through porous formations. The presence of such gaseous hydrocarbons at or near the surface may well indicate the existence of oil at some distance in a roughly vertical direction. Gas

DEVELOPMENT OF U. S. PETROLEUM PRODUCTION

(Source: *Petroleum Facts and Figures*, 1959 ed.)

Year	Oil and Gas Wells Drilled Annually	% Dry Wells Annually	Total Producing Oil Wells	Annual Crude Oil Production	Annual Crude Oil Imports	Annual Crude Oil Demands	Cumulative Petroleum Discoveries	Cumulative Petroleum Production	Cumulative Petroleum Reserves	Average Annual Production per Oil Well	Year
				(000 barrels)							
1859	2	50.00	1	....	....	....	....	....	....	....	**1859**
1869	1,682	41.38	3,737	....	....	.. .	....	....	....	....	**1869**
1879	2,817	5.25	15,571	....	....	....	....	....	....	....	**1879**
1889	6,697	16.71	21,833	....	....	....	....	....	....	....	**1889**
1899	14,353	18.82	69,673	....	....	....	3,439,984	939,984	2,500,000	....	**1899**
1909	18,327	18.57	146,736	....	....	....	6,368,307	2,168,307	4,200,000	....	**1909**
1919	29,173	20.52	228,084	378,367	52,822	429,088	11,686,939	4,986,939	6,700,000	1,659	**1919**
1929	26,356	30.03	328,200	1,007,323	78,933	1,050,440	25,450,472	12,250,472	13,200,000	3,069	**1929**
1939	27,717	24.62	380,390	1,364,962	33,095	1,335,381	40,932,845	22,449,833	18,483,012	3,325	**1939**
1949	39,015	34.12	448,680	1,841,940	153,686	1,998,897	63,557,436	38,907,947	24,649,489	4,105	**1949**
1958	49,142	39.40	574,905	2,448,837	348,007	2,815,927	90,330,632	59,794,715	30,535,917	4,259	**1958**

surveying may be performed in the layers near the surface over an area suspected of having producing formations below. It may also be done at various depths in the course of drilling when it is known as gas logging.

In the surface layers, methane alone among the light hydrocarbons may be formed by biochemical processes. It has been shown beyond reasonable doubt, however, that hydrocarbons of higher molecular weight are characteristic of oil and, through their presence, of an oil-gas deposit. The newer procedures of high analytical sensitivity have made possible the detection of such anomalies. Gas chromatography is one example and it may be called upon to measure concentrations of 60×10^{-5} per cent in the Kuibyshev Region or 250×10^{-5} per cent, as in the North Caucasus.

L. Horvitz, in describing gas surveying in the United States, reproduced a map of the Hastings field of Brazoria County, Texas. He called attention to a double band of high hydrocarbon concentrations which might indicate a new, potentially productive section. It remains to be seen whether this proves to be true.

During an eleven-year period, there have been 61 gas surveys in the Western Hemisphere covering 20,000 acres or more in each case. Of 39 anomalies so discovered, 59 per cent have been confirmed, by drilling, to be productive. It appears that in its present stage of development gas surveying is best adapted to reconnaissance prior to the use of more precisely-proved exploration methods.

The presence of significant hydrocarbons near the surface can also be discovered by observations of the microflora, particularly in well waters. Great care must be used in interpretations because propane-oxidizing bacteria can adapt themselves to other nutrients. There have been many examples, however, of an indicator microflora population in districts where oil was subsequently discovered. This is notably the case in the North Caucasus. Microbiological evidence is consistently absent in regions devoid of oil and gas.

Radio-geochemical methods are also related to hydrocarbon-gas concentrations insofar as the radioactive isotopes involved are primarily in the surface ion-exchange materials of the rocks. Volatile hydrocarbons from oil deposits may well interfere with ion-exchange processes at or near the surface. Anomalous distributions result, the concentrations of secondary radioactive elements being lower above oil deposits than elsewhere.

Electronic Exploration Methods

New steps forward in electronics are giving petroleum exploration more and more powerful tools. Sonic velocity logging in new wells is often more effective than electrical logging in identifying the same formation in two or more different wells. Additionally, in certain rocks, a clue to porosity is obtained.

Improved electronic materials, instruments, and circuits lead to greater sensitivity and to miniaturization. The airborne magnetometer is a recent development enabling exploration crews to cover with rapidity and ease areas which were accessible previously only with the greatest difficulty. The scintillation counter which was developed with no thought of petroleum exploration in mind has proved to be valuable even in airborne surveys at altitudes of 200-500 feet and speeds of 150-180 miles per hour.

Exploration research in the future, then, can be expected to aim at geophysical methods of greater sensitivity and portability, and at more nearly direct methods depending on evidences of oil which have not been sought extensively until now. Increasingly sensitive instruments will be developed for the purpose, and a constant alert will be maintained for instruments that can be adopted from other technologies. Successful research of this sort will enable us to wildcat where oil has not been suspected. Even more importantly, exploration can be accomplished with speed and with less expense in vast new areas which are conceivably as rich as the rest of the world in oil reserves.

Production

Among the numerous costs eventually appearing in the various products of petroleum, production is not large. In the aggregate, however, a producer will find the annual expense of drilling wells and getting crude out of the ground and preparing it for transportation to be such that efforts to reduce the dollars so expended are well worth while.

Reduced to its elements, the drilling phase of production merely amounts to altering rock in such a way that it may be removed, leaving a hole. So far, this has been done by actual use of drills, but the drilling operations of the future may involve no drill.

With considerable knowledge already of the effects of high temperature, explosives, sound, and ultrasound, drilling research of the future will undoubtedly be directed toward procedures that will apply energy efficiently, reduce manpower needs at the rig, and even eliminate the rig as we know it now. There will be no reduction in efforts to improve conventional drilling still further. Like the blast furnace, this has been too successful a process to assume that it will become obsolete overnight. Modern demands on drilling methods are far beyond anything contemplated at the beginning of the present era of production. In 1901, Spindletop was completed at 1200 feet with a 30 horsepower rig. Modern rotary rigs may have 2500 horsepower, and a hole has been drilled to 25,000 feet.

Offshore drilling, as on the North American Continental Shelf or in the Persian Gulf, is an extremely expensive undertaking. Improvements in wellmaking will be welcomed especially warmly in such operations. It seems likely that petroleum production will benefit from the research involved in the drilling of the so-called Mohole and its penetration of the Mohorovicic layer.

Production research of the future will, therefore, give much attention to faster and more economical ways of making, in rock, holes a few inches in diameter, many thousands of feet long, and aimed with precision. Some of the achievements sought will be removal of the torsional stress and much of the tensile stress from the drill string, substituting perhaps only a flow of electrical current. Drillers will seek reasonable assurance that the drill head, whatever it may become, will stay down until full depth has been reached. In addition, research— through application of physical chemistry and mineralogy—will attempt to improve the suspending properties and the viscosities of muds used to remove crushed rock from the wells. It will seek still better means of logging in order to anticipate producing formations, to draw analogies with nearby wells, and to gauge formation porosities.

The potential benefits of plasma techniques will be investigated. These extreme high-temperature jets could be useful in the controlled destruction of rock, but using them in the confined space of a well bottom

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Dr. Croxton has been associated with much chemical and chemical engineering research during his more than 20 years at Battelle. Recently, he has been particularly interested in petroleum research, in radiation chemistry, and in nonclinical medical research. During their formative years, he played an important role in the establishment of the Battelle laboratories in Frankfurt, Germany and Geneva, Switzerland. Through his travels and correspondence, he has gained extensive knowledge of European scientific developments including research on petroleum. A former vice president of the American Association for the Advancement of Science, Dr. Croxton also participates in the work of other scientific and professional societies. Currently he is a member of the Research Committee of the American Institute of Chemical Engineers and chairman of its Subcommittee on Research Needs.

poses practical problems of extreme difficulty, not the least of which is where, if at all, does mud come into the picture.

Several methods have been used for fracturing formations to increase oil flow. Still better ones are needed and will be sought both in the area of explosives and in the area of slow applications of pressure and granular-material injection. The effects of underground nuclear explosions will be studied with interest.

Conservation practices will become increasingly important as real prices of crude advance and as United States reserves decrease with respect to domestic consumption. Conservation will be maximized through the joint effects of proration and the best possible reservoir management. Miscible-phase displacement is a comparatively new secondary-recovery procedure showing much promise. To be of maximum usefulness, it will require an extensive program of research and development during the next few years. Even newer is thermal drive which involves heating the crude-oil deposit. It appears most likely that the heating will be done by underground combustion, probably of some of the oil itself. At the elevated temperature, oil viscosity will certainly be reduced and flow toward and into wells will be accelerated. In addition, however, it is believed to be entirely possible to attain cracking temperatures leading to what would amount to an *in situ* vis-breaking operation on the crude. There would inevitably remain a carbon-rich residue in the formation which would indeed, add fuel to the fire, and fuel of practically no value, at that.

The American Petroleum Institute's estimated U.S. recoverable petroleum reserves of 36.7 billion barrels, at the end of 1958, are based on recovering 30 per cent of the crude oil in place by present production methods and under current economic conditions. J. C. Donnell II believes that research and its applications during the next ten years or so should permit recoveries of 45 per cent, clearly a welcome addition of 50 per cent to the oil which we may expect to obtain from known reserves.

Transportation

The transportation of crude petroleum and its products has evolved steadily toward greater rapidity and versatility and will undoubtedly continue to do so in the future. Three years ago it could have been predicted that one area of development might be in tankship transportation of liquid methane. Today, the *Methane Pioneer* has made many trips between American Gulf ports and England, demonstrating the technical feasibility of this method of augmenting Britain's fuel-gas supply. The Gas Council has recently signed an agreement which should add 10-15 per cent of Saharan methane to British gas supplies. Transportation will be in the refrigerated tankers of Conch International Methane.

Petroleum transportation is accomplished by tankers and barges, rail, pipeline and truck. All of these carriers have increased in capacity and speed during recent years. The migration of crude sources from consuming areas, such as Pennsylvania, to remote wilderness areas, such as northwestern Canada and the Sahara, add to the importance of cheap, rapid, and reliable transportation.

Much of the international transportation of crude and its products involves ocean traffic. Investigations, both technical and economic, must be continued on an expanded basis to yield better and cheaper methods. The vagaries of supply and demand plus the effects of international tensions make the time between tanker shortages, as during the Suez crisis, and extensive tanker layups, as at present, very short.

The Dracone flexible oil barge is an example of a radical departure which is increasingly characteristic of the current and future research to be expected in petroleum transportation. Strange to relate, this flexible, collapsible, and almost entirely submerged, seagoing container was developed by a group at Cambridge University, under a professor who was well known for his contribution to the knowledge of high-temperature heat transfer. After the original concept, hydrodynamic considerations were used in the design, and materials of construction then became important. Currently the preferred material is rubber reinforced with nylon fabric. These barges have already been used commercially on the Niger River and along the British Coast. One of their advantages is that after discharging their cargo, they can be rolled into a comparatively small package to be shipped back to the source as ordinary cargo. Besides this, their draft is small and they are relatively resistant to collisions. There are still a number of materials problems, but there is little question that the solutions will be forthcoming, perhaps through some of the industry's own petrochemical research.

Typical of increasingly difficult transportation problems facing the petroleum industry is the conveyance of crude or especially methane from North Africa to the consuming centers of Europe. A rigid pipeline similar to that used on land is one method, but the magnitude of the corrosion problems will be obvious. In addition to that, the choice of route seems to lie be-

tween a relatively long stretch with depths as great as 8,000 feet, or a narrow crossing encountering difficult submarine ridges but depths no greater than 2,000 feet. An alternative will have a commercial performance test in the Straits of Georgia between the mainland of British Columbia, not far from the city of Vancouver, and Vancouver Island on which the principal city is Victoria. A flexible pipeline made up of layers of plastic, steel tape, cotton, lead alloy, jute, steel wire, and bituminous coating ultimately attaining an outside diameter of 7.5 inches with an inside diameter of 4.8 inches, will span the 53 miles in duplicate, will reach a depth of 810 feet and will transmit natural gas at a pressure of 1500 pounds/square inch. This pipe is an outgrowth of that used in Operation Pluto set up for the Normandy landings in 1944. Its design has also benefited from the principles of high-voltage electric-cable-construction practice and thus illustrates the impact of research in several different fields and for several different purposes for the achievement of a specific goal. In fact, 5 years ago, 93 miles of 138 kilovolt cable was laid across the Straits of Georgia very close to the proposed crossing of the gas pipeline. It has been in continuous service ever since. The gas transmission line is expected to convey 50 million cubic feet of methane per day, which is equivalent to a rating of 200 megawatts. The importance of flexible pipeline for other crossings such as the Mediterranean, the English Channel, the Oresund, or the Baltic can be defined only as a result of further technical and economic research.

Paraphrasing Messrs. Foster and Elliott of the Standard Oil Company of Ohio, it can be said that after drilling nine exploratory oil wells, eight of which are dry holes and all of which average a mile in depth, crude oil is found in one, is pumped to the surface, desalted and transported to a refinery which may be 1500 miles away while, in the meantime, repressurizing may be taking place in the field. At the refinery the crude is converted into hundreds of products which are transported to a bulk storage point where 30-days' supply is maintained. The gasoline, which is made up of a number of chemically converted materials, is then transported to a service station so reliably that a shortage is never found, and it is sold to the ultimate consumer for about 3 cents a pound without tax. This price is to be compared with 4 cents for a pound of water which has merely been distilled once or twice, 25 cents for a pound of bread, 11 cents for a pound of milk, and 15 cents for a pound of structural steel. There is not the slightest doubt in the world that both the price and the quality have been made possible by research and development.

ENGINEERING CHALLENGES PUBLIC UNDERSTANDING

"Engineering, as the closest coupling of science to society, is too widely celebrated for its utility and not enough for its creativity. What is more, engineering derives as much historical significance from the challenges it lays to understanding as from the applications it makes of understanding. Engineering and technology, more than education or the media of mass communication, have popularized the lessons science has to teach society. In the realm of physics, for example, it is technology that has impressed the permutability of matter and energy on popular understanding. Equally, it is the control rather than the understanding of nature that has impressed on all men the ultimate discovery of science: that man is responsible for his own destiny and must become the conscious master of his fate."

Gerard Piel, publisher, *Scientific American*

NOTES from BATTELLE

✻ MUSHROOM MYCELIUM AS FOOD

The search for a food that can be produced economically in very large amounts has led to the study of morel mushrooms. These mushrooms are an excellent source of protein, and their thread-like mycelia can be grown in deep-tank aerated cultures in the form of ¼ to ⅜-inch round pellets in periods as short as 4½ days. Moreover, certain species have desirable flavors that make them more attractive for human food than algae and yeasts, which may also be grown in aerated liquid cultures.

According to John H. Litchfield, Reynolds C. Overbeck, and Richard S. Davidson of Battelle, the mycelia of some morel mushrooms can be raised in waste materials such as cheese whey and in simple media containing glucose, maltose, or lactose (which may be prepared from wastes) as carbon sources. Their studies showed that the protein content of the mushroom mycelium was approximately 30 per cent.

The researchers conclude that morel mushroom mycelium should be given serious consideration as a source of protein. When the mycelia of various species, in powdered form and in soups, were evaluated by a taste panel, the species *Morchella esculenta* was characterized as mildest and *M. crassipes* strongest in flavor, while *M. hortensis,* intermediate between the two, was found most appealing to human taste.

✻ INDUSTRIAL R&D SPENDING, 1960

Research and development performed by private industrial firms in 1960 amounted to $10.5 billion, according to the National Science Foundation. This represents a 10 per cent increase over the $9.6 billion total for 1959. Of the $10.5 billion, $6.1 billion, or 58 per cent, was financed by the Federal Government. The 1961 total for industrial R&D is expected to reach about $11 billion.

Industrial firms, in 1960, performed about three-fourths of the nation's dollar volume of research and development, which is estimated at $14 billion. The remaining fourth was conducted by the Federal Government, colleges and universities, and other not-for-profit organizations.

As compared with the 58 per cent financed by the Federal Government in 1960, it financed, in 1953, only 39 per cent of total research and development performed by industry.

Two industries far surpassed all others in funds for R&D performance in 1960—aircraft and parts ($3.5 billion), and electrical equipment and communication ($2.4 billion). Other industries with large research and development activities were chemicals and allied products ($1 billion), machinery ($993 million), and motor vehicles and other transportation equipment ($849 million). These five industry groups accounted for more than four-fifths of total R&D performance in 1960.

✻ WELDING TITANIUM PLATES

The welding of titanium plates up to ⅝ inch thick has been attended by extensive weld-joint cracking. Cracking may now have been overcome as the result of research for the Bureau of Naval Weapons. In a comprehensive program to evaluate titanium alloys for submarine hulls, Battelle welding experts produced crack-free welds in 120,000-psi yield, 2-inch-thick titanium alloy plates.

In a technical paper presented recently before the annual meeting of the America Welding Society in Dallas, Wallace G. Lewis, Glenn E. Faulkner, and Perry J. Rieppel reported that weld-joints were produced, the properties of which equaled or exceeded those of the base alloy. Their report concludes: "On the basis of these welding studies, we believe that titanium alloys can be used for submarine hulls."

Welds were made in plates with a double-vee joint design using an automatically controlled consumable-electrode process. To prevent contamination which might cause weld cracking, all welding was done in an argon-filled chamber. Welding conditions of 365 amps, 32 arc volts, and a 15-inch-per-minute travel speed were used to produce heat input of about 45,000 joules per inch.

The best combination of yield strength and impact properties was obtained with commercially available Ti-6Al-4V alloy plates and an experimental 5Al-2Cb-1Ta alloy filler wire. However, according to the authors, plates with even better strength and impact properties might be produced by slight changes in the composition of the plate and filler alloys.

✻ OXYGEN FROM WATER

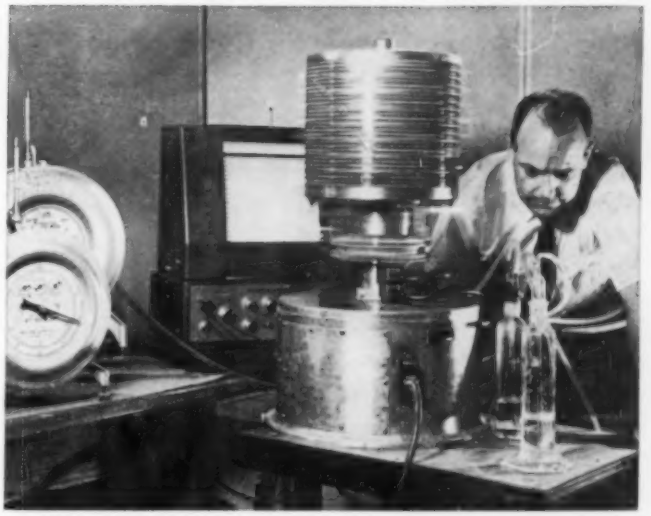
An electrolytic cell, which operates under weightless conditions, has been developed as a link in a workable chemical system for converting an astronaut's breath into breathable oxygen during space voyages lasting up to two years. Battelle is now readying a prototype model of the rotating cell for evaluation by the Aerospace Medical Laboratory, a component of the Air Force Systems Command's Aeronautical Systems Division.

In the experimental cell, well-established principles of electrochemical engineering are used in breaking water down into hydrogen and oxygen, according to John E. Clifford, a Battelle electrochemist. The unique feature of the cell is its ability to operate efficiently independent of natural gravity. Conventional electrolytic cells depend upon the pull of this gravity on the electrolytic solution in separating gas bubbles as they are generated in the cell's liquid—just as bubbles rise in a glass of water. The experimental cell operates in its own artificial gravity field, which is the centrifugal force produced as the cell rotates.

Development of the zero-gravity electrolytic cell dovetails with the recently announced completion, by Battelle scientists, of a device that chemically converts the carbon dioxide in an astronaut's breath into carbon and water. The device can use the hydrogen produced by the electrolytic cell, while the cell, in turn, can make use of the water to produce more breathing oxygen. Thus, the two devices complement one another in maintaining a livable atmosphere in a spacecraft for long periods without a supplemental supply of breathing oxygen. Space and weight limitations on voyages of extended duration make it impossible to carry the necessary oxygen in tanks or in the form of chemical compounds.

Clifford, who worked with James T. Gates in designing the cell, describes it as a drum-shaped unit, about three feet high, that rotates at up to 500 rpm. The cylindrical unit is comprised of 16 individual electrolytic cells stacked one on top of the other like pancakes. Alternate metal plates serve as anodes and cathodes. Interspersed between these plates are asbestos diaphragms—thin films that separate hydrogen from oxygen as these gases are generated on the electrodes. The gases are drawn from the chamber through separate collecting systems routed up through the center of the unit. A 500-watt electrical input is required to electrolyze about two quarts of water a day—sufficient to provide oxygen for two men.

In designing the cell, the Battelle specialists considered requirements other than operation at zero gravity. They were asked to design the smallest and lightest unit possible to provide oxygen for two men, a unit that required a minimum of electrical power and that would be strong enough to withstand forces 15 times the pull of gravity. High reliability, with a minimum of maintenance for two years, was an important requirement.



Battelle's John E. Clifford checks the output of the rotating electrolytic cell designed to operate independent of natural gravity. One of the bottles in the foreground demonstrates production of hydrogen within the cell, and the other demonstrates production of oxygen, with both gases being bubbled through a solution.

✻ CONTRACT RESEARCH IN EUROPE

"Contract research is an unquestionable success in Europe," David C. Minton, Jr., vice president of Battelle, told delegates to the National Conference on the Administration of Research meeting last month in San Juan, Puerto Rico. This success is due, in part, to the rapid industrial growth in Europe since World War II, he observed, and was attained in spite of problems attending pioneering efforts to establish contract research organizations in the postwar years.

Minton played a key role in planning the establishment of Battelle laboratories in Frankfurt, Germany, in 1952, and in Geneva, Switzerland, in 1953. He cited Battelle's experiences in Europe to illustrate the course of European contract research in the past decade.

"The concept of contract research, which took so long to mature in the United States," he added, "had proven successful there and needed only to be actively

and properly introduced in Europe. The methodology and organization of the contract research laboratory was well developed and needed only to be adapted to European requirements. And, finally, the initial facilities that were established were adequate to permit these operations to get on a self-supporting basis within a few years."

The American planners of Battelle's European laboratories made their principal miscalculation in underestimating the cost of communication, Minton reported. "According to our original plan, it was thought that our operations in Europe could be technically supervised from the mother laboratory in Columbus through the reports, correspondence, and visits of our senior technical staff members. This plan was abandoned when it was found ineffective and expensive.

"As the organizations and methods of operation became established, we withdrew our American staff members and by early 1958, there were no American Battelle staff members resident in Europe. The initial reason for this withdrawal was largely economic, but more important was the fact that our European staffs were organized, the laboratories were functioning, and our European directors had demonstrated their ability to efficiently manage the operations. Today, these European laboratories are, for all practical purposes, autonomous."

Touching briefly on the comparative cost of research in the United States and in Europe, the Battelle executive said: "There is a popular conception that American companies can buy research cheaper in Europe than in the United States because the salaries of scientists and engineers in some of the more industrially advanced countries, such as England and Germany, are substantially lower than in the United States. Even with nine years' experience in conducting contract research in Europe on problems similar to those we have worked on in the United States, we, ourselves, do not believe that American companies can get research done cheaper in Europe, if the cost of communication is considered."

THE GROWING INTEREST IN LITHIUM is reflected in the recently published Supplement No. 8 of the *Annotated Bibliography on the Use of Organolithium Compounds in Organic Synthesis.* The present Supplement contains 620 abstracts of materials published during 1960, as compared with 487 publications abstracted for 1959 and only 136 abstracted for the first Supplement published in 1950.

As in the past, main emphasis is on the use of alkyl- and aryl-lithium compounds in Grignard-type reactions. However, papers reporting reactions in which metallic lithium acts as a reducing agent in ammonia and amines, and papers on the use of lithium and lithium organic compounds as catalytic agents in the preparation of polymers have also been included.

Supplement No. 8 was compiled by Florence A. Emert, James H. Schwartz, Robert W. Gibson, Jr., and Ralph L. Darby, all of Battelle. It is available, at $3, from the Technical Service Division, Lithium Corporation of America, Inc., Box 428, Bessemer City, North Carolina.

A DETAILED CHART, showing Battelle's areas of research interest and competence, is available, on request, to those concerned with research and development. Hundreds of types of specialized research are grouped under 10 major areas—biosciences, ceramics, chemical engineering, chemistry, economics, electronics, mechanical engineering, metallurgy, nuclear energy, and physics. The 16 by 21-inch color chart may be obtained by writing the Publications Office, Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio.

BATTELLE STAFF MEMBERS recently named to technical posts include: *Ronald J. Favor*—chairman, Statistical Design Allowables Subcommittee, Air Force - Navy - Federal Aviation Agency Panel; *J. Harry Jackson*—member, Standing Committee on Engineering Management, American Institute of Mining, Metallurgical and Petroleum Engineers; *Richard L. Jentgen*—technical representative, National Lubricating Grease Institute; *Herbert S. Kirschbaum*—member, Research Committee, American Institute of Electrical Engineers; *David W. Locklin*—member, Technical Committee on Combustion and Fuels, American Society of Heating, Refrigeration, and Air Conditioning Engineers; *E. H. Lougher*—co-chairman, Joint AIEE-IRE Subcommittee on Thermoelectric Devices, representing AIEE, also, member, Solid State Devices Committee, AIEE; *Roger L. Merrill*—member, Research Committee, AIEE; *J. Mason Pilcher*—director, American Association for Contamination Control; *Duane N. Sunderman*—member, Subcommittee on Radiochemistry, Committee on Nuclear Sciences, National Academy of Sciences-National Research Council; *William W. Vogelhuber*—member, Junior Committee, American Society of Mechanical Engineers.

BATTELLE TECHNICAL REVIEW

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ADMINISTRATION AND PHILOSOPHY OF RESEARCH

° **Program Evaluation** and Review Technique.— Reviews techniques being developed to strengthen the weakest phase of the research management cycle: the evaluation phase. — David G. Boulanger. *Advanced Management*, v. 26, July-Aug. 1961, p. 8-12.

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Two-Fluid **Model** for the Structure of **Neutral Shock Waves.** — Recent measurements indicate that the thickness of weak and moderate strength shocks ($M < 2$) is given accurately by the Navier-Stokes equations, whereas there is good reason to believe that the bimodal theory of Mott-Smith is a better description for strong shocks. It is therefore desirable to develop a theory that can account for shock structure at both large and small Mach number. Results of a promising two-fluid theory by Glansdorff are recomputed and the formulation is criticized. A modified two-fluid approach is developed, employing moments of the respective Boltzmann equations for each fluid, and employing an intermediate Maxwellian distribution function with a mean flow velocity and temperature at the center of the shock to account for irreversible particle transfer between the two fluids. — S. Ziering, F. Ek, and P. Koch. *Physics of Fluids*, v. 4, no. 8, Aug. 1961, p. 975-987.

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Correlation Between Base Composition of **Deoxyribonucleic Acid** and Amino Acid **Composition of Protein.** — Noboru Sueoka. *National Academy of Sciences, Proceedings*, v. 47, Aug. 1961, p. 1141-1149.

Antiviral Effect of Guanidine.— Soluble **guanidine salts** show an antiviral effect on poliovirus and on some other enteroviruses. — Wilton A. Rightsel, et al. *Science*, v. 134, Aug. 25, 1961, p. 558-559.

• The Changing Concept of **Auxin.**— The concept of auxin as only a **cell-enlargement regulator** can no longer accommodate the variety of growth phenomena controlled by auxin. In isolated tissues, auxin interacts with **gibberellin** in the control of cell enlargement, and auxin and **kinin** interact in initiating **cell division.** Some evidence suggests a single site of auxin action for both processes. It is proposed that auxin is not a determining agent but a predisposing agent, causing the production of something in limiting amount which is required in both processes. — N. P. Kefford and P. L. Goldacre. *American Journal of Botany*, v. 48, no. 7, Aug. 1961, p. 643-650.

• **Drug-Induced** Immunological "Tolerance" for Homotransplantation.— **Immunological "tolerance"** to tumor homografts may be induced in mice by pretreatment with A-methopterin and a suspension of viable cells from an appropriate foreign strain. This has been accomplished in 3 different strain combinations which varied in their genetic incompatibility. To induce a "tolerance" state, the cells of the appropriate foreign strain and a therapeutic dose of the antimetabolite must be administered over a prolonged period of time. — Delta E. Uphoff. *Transplantation Bulletin*, v. 28, no. 1, July 1961, p. 110-114.

• On the Origin and Planetary Distribution of Life.— A discussion of current opinion and speculation concerning the **origin of life** on Earth, with particular emphasis on the role that radiation may have played, and with application to the problem of **extraterrestrial life.** The production of organic molecules in the atmosphere and on the surface of the primitive Earth is outlined, the origin of the first self-replicating system from these molecules is discussed, the radiation hazards to the first organisms are examined, and possible radiation defense mechanisms and their relation to the early evolution of life are described. Finally, the application of these concepts to the possibility of life on other astronomical bodies is discussed. — Carl Sagan. *Radiation Research*, v. 15, no. 2, Aug. 1961, p. 174-192.

• Physical Aspects of Protein and **DNA Synthesis.**— The idea that the processes of DNA and **protein synthesis** in a bacterial cell take place by random collision and specific selection has been examined in terms of Brownian movement theory. — Ernest Pollard. *Journal of Theoretical Biology*, v. 1, no. 3, July 1961, p. 328-341.

Pharmacologically Active Substances Present in the **Central Nervous System.**— The author believes that it is significant that of all the substances postulated to officiate as neuro-mediators or incriminated in the etiology of mental illness, only acetylcholine possesses neuronal and synaptic facilitating properties. It would appear that **acetylcholine** is the driving force in the

nervous system whereas the remaining substances simulate physiological brakes. The phrenotropic agents widely employed in the **pharmacotherapy** of various forms of mental illness obviously modify brain biochemistry, some perhaps via mitochondrial receptor attachment, with apparently consequential effects on the psyche. – Paul V. Buday. *Nature*, v. 191, July 15, 1961, p. 245-247.

• **Colour Discrimination.**– Review article. – Jennifer Birch and W. D. Wright. *Physics in Medicine and Biology*, v. 6, no. 1, July 1961, p. 3-24.

• The **Radioprotective Action** of Parathyroid Extract.– The protective action of a single post-irradiation injection of **parathyroid extract** in X-irradiated rats has been confirmed. The effectiveness of the extract (as a difference in survival percentage) was greatest in rats exposed to 800 r of X-rays. With this dose, the level of protection was maximum and independent of the amount of extract (administered 5 min after irradiation) between 50 and 200 USP units. The extract was totally ineffective when injected 5 hours after irradiation. – R. H. Rixon and J. F. Whitfield. *International Journal of Radiation Biology*, v. 3, no. 4, July 1961, p. 361-367.

• **A Neural Mechanism** for the **Immediate Recall** of Sequences. – Two stages in the **learning** of a sequence are distinguished: immediate reproduction of a presented sample, and reproduction of habitual responses by association, without the necessity of recent access to the original sample. The model is primarily concerned with performances of the first type. – P. M. Milner. *Kybernetik*, v. 1, no. 2, July 1961, p. 76-81.

Isolation and Identification of a Neuroactive Factor From *Lathyrus latifolius*.– A **neuroactive principle** has been isolated in crystalline form as a monohydrochloride and has been identified as L-α,γ-diaminobutyric acid. This amino acid has also been found in very high concentration in the toxic seed of **Lathyrus** sylvestris Wagneri. – Charlotte Ressler, Paul A. Redstone, and Renée H. Erenberg. *Science*, v. 134, July 21, 1961, p. 188-190.

Enzymatic Formation of Psychotomimetic Metabolites From Normally Occurring Compounds.– An enzyme has been found that N-methylates serotonin and tryptamine to **psychotomimetic metabolites,** bufotenine, and N,N-dimethyltryptamine. This enzyme is highly localized in the rabbit lung and also N-methylates phenylethylamine derivatives such as tyramine, phenylethylamine, mescaline, and dopamine. – Julius Axelrod. *Science*, v. 134, Aug. 4, 1961, p. 343.

Polynuclear Aromatic Hydrocarbons, Steroids and Carcinogenesis.– In addition to the electronic factors, there is a steric factor responsible for the **carcinogenicity** of polynuclear aromatic hydrocarbons. A carcinogenic polynuclear aromatic hydrocarbon must bear steric resemblance to **steroids.** One possible implication to this requirement for carcinogenicity is that these hydrocarbons may act on the same sites as steroid hormones. – N. C. Yang, A. J. Castro, M. Lewis, Ting-Wa Wong. *Science*, v. 134, Aug. 11, 1961, p. 386-387.

Location of **Polygenes.**– Describes procedures for the **location** of polygenes on chromosome **linkage maps** and discusses its use with *Drosophila*. – J. M. Thoday. *Nature*, v. 191, July 22, 1961, p. 368-370.

CERAMICS AND CONCRETE

• Quartzite in Ramming Mixtures for **Induction Furnace Linings.**– Ramming mixtures are used in induction furnaces because a monolithic crucible is needed. **Quartzite ramming mixtures** are preferred because there is no shrinkage or formation of cracks even during sintering. The quartzite used must remain compact and stable during transformation. The sintering agent must cause the grains of the ramming mixture to bond together, and the surface of reaction to contract. Careful drying of the ramming mixture is necessary before heating. (*In German.*) Quarzit in Induktionsofenstampfmassen. – Rudolf Rasch. *Giesserei*, v. 48, no. 16, Aug. 10, 1961, p. 457-461.

Materials of Construction. **Concrete.**– Surveys types, properties, and applications. – W. H. Kuenning, G. E. Monfore, and George Verbeck. *Industrial and Engineering Chemistry*, v. 53, Sept. 1961, p. 73A-75A.

a

• New Light on the **Structure** of Glass.– The theory of network imperfections provides an explanation of the **discoloring** of **glass** under short-wave irradiation. Some practical applications of this theory are discussed. – J. M. Stevels. *Philips Technical Review*, v. 22, nos. 9-10, 1960-1961, p. 300-311.

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b • Automatic Control in **Glass Manufacture.**– Parameters that can be subjected to **automatic control;** requirements to be met by instrumentation. – P. M. Cupido. *Philips Technical Review*, v. 22, nos. 9-10, 1960-1961, p. 311-319.

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Improved Forms of Industrial **Graphite.**– Authors stress that even though the graphite industry produces many tailor-made grades, it is important to consider their cost. Some of the newer ones are expensive and will have restricted use. – F. K. Earp, A. R. Ford, and R. K. Hurden. *Engineering*, v. 192, Aug. 11, 1961, p. 178-179.

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Surface Treatment of Glass.– The effort to capture more of the inherent strength of **glass containers** involves coatings to minimize bruises and abrasions. A review of available methods. – J. W. Hackett and H. A. Steigelman. *Modern Packaging*, v. 35, no. 1, Sept. 1961, p. 146 + 4 pages.

d

Hot-Pressing of **Alumina Powders** at Low Temperatures.– Densification during **hot-pressing** at relatively low temperatures was investigated. The effects observed, particularly those due to particle size and pressure, refute the claim that plastic flow is the predominant mechanism for densification in the observed pressure-temperature range. An important step in the densification of a compact appears to be a rearrangement of the particles which may take place by various particle-sliding, fragmentation, plastic-flow, and diffusion processes. – E. J. Felten. *American Ceramic Society, Journal*, v. 44, Aug. 1961, p. 381-385.

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CHEMICAL ENGINEERING

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Preparation of Silicon Tetrachloride.– Preparation of silicon tetrachloride by the **chlorination of ferrosilicon.** The work included ultraviolet irradiation of the reaction system. A small **pilot plant** using the exothermic reaction has been designed and operated. – W. R. Barnes and H. G. Emblem. *Industrial Chemist*, v. 37, Aug. 1961, p. 385-387.

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Production of **Fluorspar, Hydrofluoric Acid** and **Fluorides.**– *Industrial Chemist*, v. 37, Aug. 1961, p. 379-383.

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h • New Concepts in **Filtration.** II. Theoretical Concepts. – K. J. Ives. *Water and Water Engineering*, v. 65, Aug. 1961, p. 341-344.

• Production of Pure **Molybdenum Disulphide.**– Excellent quality of product is obtained by a **flotation-leaching-chemical refining** method. – Ernie Borbash. *Canadian Mining Journal*, v. 82, Aug. 1961, p. 66-69.

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i • **Mass Transfer** With and Without Chemical Reaction.– Rates of dissolution of cast solids in a baffled agitated vessel were obtained for various systems. Reaction factors, k_L/k_L^0, were measured in the agitated vessels for the systems. Reaction factors were also measured in diaphragm-type diffusion cells for the system benzoic acid-sodium hydroxide. The results provided quantitative support for the **ion-diffusion theory in a stagnant film.** – J. Marangozis and A. I. Johnson. *Canadian Journal of Chemical Engineering*, v. 39, no. 4, Aug. 1961, p. 152-158.

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Explosions and Detonations in **Chlorine Production.** – William C. Eichelberger, Bronislaw B. Smura, and Walter R. Bergenn. *Chemical Engineering Progress*, v. 57, Aug. 1961, p. 94-97.

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A Comprehensive Approach to the Analysis of **Cooling Tower Performance.**– Donald R. Baker and Howard A. Shryock. *ASME, Transactions, Series C, Journal of Heat Transfer*, v. 83, no. 3, Aug. 1961, p. 339-350.

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Applying Cascade Theory in **Distillation.**— Cascade theory of separational processes removes McCabe-Thiele's principal restriction. While increasing understanding of standard procedures, **cascade theory** is also a useful tool for optimizing multiple-unit installations. — W. Dan Maclean. *Chemical Engineering*, v. 68, Aug. 21, 1961, p. 123-125.

• Coal by Pipeline.— **Economic aspects** of **coal pipelines** in current use throughout the world. — A. N. Sharp. *Coke and Gas*, v. 23, Aug. 1961, p. 336-338.

• **Ozonization** of Chattanooga **Uraniferous Black Shale.**— Ozone was produced by a laboratory-type, silent-discharge ozonizer used in previous work on coal. The concentration of ozone was 3.5% by volume at an oxygen flow rate of 9 liters per hour. — C. R. Kinney and J. T. Leonard. *Journal of Chemical and Engineering Data*, v. 6, no. 3, July 1961, p. 474-476.

• Microbiological and Operational Investigation of Relative Effects of Skimming and *in Situ* Sand Washing on Two Experimental **Slow Sand Filters.**— Hydraulic investigations concerned with the design of the plant, and with the long-term effects on filtration, particularly in relation to the bacteriological quality of the filtrate, are described. Some fundamental observations are made on **bacterial changes** occurring in the supernatant water and the sand during filtration. — N. P. Burman and J. Lewin. *Institution of Water Engineers, Journal*, v. 15, no. 5, Aug. 1961, p. 355-367.

• Activated Carbon for Treatment of Conditions Attributed to **Synthetic Detergents.**— Suggests **activated carbon** for treatment of water supply rendered impure by improper disposal of household detergents. — E. A. Sigworth. *American Water Works Association, Journal*, v. 53, Aug. 1961, p. 1003-1006.

• Practical Progress in **Distillation.**— In **packed columns** and **molecular stills.** — K. E. Porter. *Manufacturing Chemist*, v. 32, Aug. 1961, p. 350-353.

CHEMISTRY—ANALYTICAL (ORGANIC AND INORGANIC)

• Preliminary Study of the Dosage of the Elements by **Neutron Activation** Based on the Formation of Short Time Isotopes: Rapid Separations and Determination of the Losses.— The authors submit a method for the rapid **separation of Co by toluene extraction** of its β-nitroso-α-naphthol complex, with estimation of the losses involved. Iron, the chief element causing disturbance in assay by gamma spectrometry (^{60}Co) after activation gives a complex with sodium fluoride-acetate-citrate in a medium at pH 5-6 and remains quantitatively in the aqueous phase. In this way it has been possible to separate 0.1 μg of Co in presence of 100 mg of Fe. (*In French.*) Etude préliminaire au dosage des éléments par activation aux neutrons, basé sur la formation d'isotopes à courte période: séparations rapides et détermination des pertes. — D. Monnier, W. Haerdi, and J. Vogel. *Helvetica Chimica Acta*, v. 44, no. 4, 1961, p. 897-903.

• **Semiautomatic Titration Device** for the Determination of Low Amounts of **Carbon Dioxide.** Use for the Direct Oxygen Determination in Organic Substance and for the C and CO_2 Determination in Aqueous Solutions.— Describes a device for the potentiometrical determination of low amounts of CO_2 (0.015-5mg) with $Ba(OH)_2$ as a titration and absorption agent. Indicates how the device can be used for the direct determination of O in organic substances according to Schütze and Zimmermann, and for the determination of traces of bound and free CO_2 and of bound C in aqueous solutions. Instances of analyses are given. (*In German.*) Über ein halbautomatisches Titriergerät zur Bestimmung kleiner Mengen Kohlendioxyd. Anwendung für die direkte Sauerstoffbestimmung in organischen Substanzen und für die C- und CO_2-Bestimmung in wässrigen Lösungen. — S. Gorbach and F. Ehrenberger. *Zeitschrift für Analytische Chemie*, v. 181, 1961, p. 100-110.

• **Water Determination** in Organic Substances by Chemical Methods.— Makes a survey of the differences between the physical and chemical methods for the determination of water

in organic substances and of the prerequisites, properties and applications of the chemical methods. The Karl-Fischer titration, the acetyl chloride method, and the reactions of water of combustion with anorganic chlorides and liquefied organic acid chlorides are discussed. (*In German.*) Wasserbestimmung in organischen Substanzen mit chemischen Methoden. — Ernst Eberius. *Zeitschrift für Analytische Chemie*, v. 181, 1961, p. 172-180.

• A Method for the Quantitative Determination of Sugars and Sugar Alcohol by **Paper Chromatography.**— The authors describe a method for the quantitative analysis of **sugars** and **sugar alcohols,** as e.g. in partial hydrogenated hydrolysates of wood containing more than 10 different compounds. The samples to be analyzed are chromatographed on paper strips by different special solvent mixtures. After development the colored bands of the various substances are evaluated by a photometer. This method opens possibilities especially in cases where it is necessary to analyze mixtures of several physical and chemical similar substances. (*In German.*) Eine Methode zur quantitativen papierchromatographischen Bestimmung von Zuckern und Zuckeralkoholen. — K. Schoenemann, G. Jeschek, and K. Frommhold. *Zeitschrift für Analytische Chemie*, v. 181, 1961, p. 338-350.

• The **Retort Method** in the **Organic Microelementary Analysis.** — The combustion of organic substances in a closed tank filled with O has a wide field of application in elementary analysis and offers the advantages of simplicity of equipment, full freedom in selecting the final determination, suitability for analyses in series in routine work, possibility of qualitative analyses and trace determination. (*In German.*) Die Kolbenmethode in der organischen Mikroelementaranalyse. — W. Schöniger. *Zeitschrift für Analytische Chemie*, v. 181, 1961, p. 28-39.

• On the Concentration and Separation of the Trace-Elements **Fe, Cu, Zn, Mn, Pb, Mo** and **Co.** II. **Solvent Extraction.** — P. C. van Erkelens. *Analytica Chimica Acta*, v. 25, no. 2, Aug. 1961, p. 129-135.

• A New Reagent for the Detection and **Gravimetric Determination** of **Sodium.** — H. Sanke Gowda and W. I. Stephen. *Analytica Chimica Acta*, v. 25, no. 2, Aug. 1961, p. 153-158.

• The Analytical Use of **Atomic Absorption Spectra.**— A method is suggested for complete vaporization of a substance in a graphite crucible. The use of this method for quantitative analysis, using atomic absorption spectra, eliminates the effect of the composition of the sample on the analytical results. A high absolute sensitivity is reached for the determination of the majority of the elements. The apparatus and experimental procedure are described, and the dependence of the degree of absorption on experimental conditions is discussed. — B. V. L'vov. *Spectrochimica Acta*, v. 17, no. 7, Aug. 1961, p. 761-770.

• Practical Methods for the **Microbiological Assay** of the **Vitamin B-Complex** and **Amino Acids.** I. — E. C. Barton-Wright. *Laboratory Practice*, v. 10, Aug. 1961, p. 543-546.

The Spectrophotometric Determination of Small Quantities of **Cobalt** in Plain and Alloyed **Steels.**— Cobalt contents down to 0.005% in plain and alloyed steels are subject to **spectrophotometric determination** as the cobaltous chloride complex in strong hydrochloric acid after the removal of interfering elements by anion exchange and amyl acetate extraction. — A. E. Sherwood. *Metallurgia*, v. 64, July 1961, p. 47-50.

• Gravimetric and Titrimetric Determination of **Bismuth** Using Ammonium Salts of Benzene and Naphthalene Selenonic Acids. — Two new reagents, $C_6H_5SeO_2NH_4$ and $C_{10}H_7SeO_2NH_4$, are suggested for the **gravimetric determination** of bismuth. — V. S. Sotnikov and I. P. Alimarin. *Talanta*, v. 8, no. 8, Aug. 1961, p. 588-592.

• The Direct Microdetermination of **Tissue Calcium** by **Flame Photometry.**— Approximately 100 mg fresh tissue containing a total of 0.5-3.0 μg Ca was extracted with trichloroacetic acid solution, and the extract was analyzed after the addition of 5 meq Na/1, 1 meq K/1, and isopropyl alcohol. Under these conditions tissue Na, K, and phosphate did not cause significant interference. The values and standard errors for fresh rat liver, heart, kidney, and diaphragm muscle were 3.96±0.11, 3.95±0.06, 5.52±0.18, and 4.83±0.23 μg Ca/100 mg, respectively. —

Robert P. Geyer and Ethel J. Bowie. *Analytical Biochemistry*, v. 2, no. 4, Aug. 1961, p. 360-369.

• Two-Component Phases in Gas Chromatographic Separations of **Steroids.**— The possible use of two-component phases and segmented packings of varying degree of selectivity in the **gas chromatographic separation** of steroids has been investigated. This highly potent technique permits the preparation of columns which exhibit specificity toward various functional groups, making it possible to distinguish between steroids differing in type and degree of substitution. — E. O. A. Haahti, W. J. A. Vandenheuvel, and E. C. Horning. *Analytical Biochemistry*, v. 2, no. 4, Aug. 1961, p. 344-352.

• Determination of Micro Quantities of **Rubber** by a Modified **Bromination Method.**— A method is described for determination of as little as 200 μg rubber with an accuracy of 96-97%. ***cis*-Polyisoprene** with average molecular weight as low as 41,000 was accurately determined employing a modification of a gravimetric bromide precipitation method. — Thomas I. Baker, Lawrence G. Jayko, Robert D. Stubblefield, and Ralph F. Anderson. *Analytical Biochemistry*, v. 2, no. 4, Aug. 1961, p. 287-291.

• Preliminary Notes on the Separation of **Nucleic Acids** and **Proteins** by **Counter Flow Electrophoresis.** — R. Eliasson, E. Hammarsten, T. Lindahl, and H. Palmstierna. *Acta Chemica Scandinavica*, v. 15, no. 3, 1961, p. 570-574.

• **Ozonolysis** of **Phenols.** I. Ozonolysis of Phenol in Ethyl Acetate.— The ozonolysis fragments, carbon dioxide, formic and oxalic acids and glyoxal, have been determined quantiatively. Possible reaction combinations are proposed to explain the experimental results. — Erling Bernatek and Carly Frengen. *Acta Chemica Scandinavica*, v. 15, no. 3, 1961, p. 471-476.

• Preparative **Gas Chromatography.**— With the gas chromatography described it is possible to separate in a separation procedure lasting from 10 to 60 min amounts as high as 50 g, in extreme cases as high as 200 g, of a mixture of vaporizable substances. (*In German.*) Präparative Gaschromatographie. — Ernst Bayer, K. P. Hupe, and H. G. Witsch. *Angewandte Chemie*, v. 73, no. 15, Aug. 7, 1961, p. 525-530.

• Determination of Radiophosphorus by Solvent-Extraction.— Describes a new method for the **determination of ^{32}P in the presence of fission products** and other radionuclides. — Harley H. Ross and Richard B. Hahn. *Talanta*, v. 8, no. 8, Aug. 1961, p. 573-578.

• Precipitation of Metal 8-Hydroxyquinolates From Homogeneous Solution. IV. Uranium.— **8-Acetoxyquinoline** can be hydrolyzed to produce 8-hydroxyquinoline and thus to precipitate metallic ions from homogeneous solution. The present paper describes an analogous method **for the precipitation of U(VI).** — Jon Bordner, E. D. Salesin, and Louis Gordon. *Talanta*, v. 8, no. 8, Aug. 1961, p 579-582.

• The Conformational Analysis of **Chlorocyclohexane** by Electron Diffraction.— Chloro*cyclo*hexane has been rigorously reexamined using the latest techniques of **gas-pase electron diffraction.** — V. A. Atkinson. *Acta Chemica Scandinavica*, v. 15, no. 3, 1961, p. 599-606.

• Direct Quantitation on Paper Chromatograms of Radioactivity From **^{14}C Labelled Fatty Acids.**— Investigation is based on experiments using reversed phase **chromatography** with horizontal development. — Heinz J. M. Hansen. *Acta Chemica Scandinavica*, v. 15, no. 3, 1961, p. 670-674.

CHEMISTRY—INORGANIC AND GENERAL

• The **Peroxide Compouds of Zirconium** as the Products of Interaction Between Hydroxide and Hydrogen Peroxide.— During reactions of $Zr(OH)_4$ with H_2O_2 under isothermal conditions at 0 and −20 C, three peroxide phases, in addition to $Zr(OH)_4$, were revealed: $ZrO_2 \cdot 2H_2O$, $ZrO_2 \cdot H_2O$ and ZrO_2. Dehydration test and differential curves concerning the heating of residues corresponding to the hard phases $ZrO_2 \cdot 2H_2O$, $ZrO_2 \cdot H_2O$ and ZrO_2 offer a basis to consider $ZrO_2 \cdot 2H_2O$ and $ZrO \cdot H_2O$ as

compounds of the hydroperoxide type $Zr(OOH)(OH)_3$ and $ZrO(OOH)(OH)$. (*In Russian.*) Perekisnye soedineniia tsirkoniia kak produkty vzaimodeĭstviia gidrookisi s perekis'iu vodoroda. — S. Z. Makarov and L. V. Ladeĭnova. *Akademiia Nauk SSSR, Izvestiia, Otdelenie Khimicheskikh Nauk*, 1961, no. 7, July, p. 1169-1175.

• Production of **Ammonium Sulfate** of the First Type.— Using a dessicator in the boiling layer revealed high efficiency in the drying quality and in productivity. In designing a commercial dessicator model, the following are some of the requirements to be fulfilled: the sulfate must be loaded directly from the centrifuges without intermediary storage, the feeder must distribute the material on the surface of the layer, the height of the chamber above the layer must be increased in order to decrease the amount of sulfate carried away by the outgoing air. (*In Russian.*) Poluchenie sol'fata ammoniia pervogo sorta. — K. P. Popov and V. F. Sokolov. *Koks i Khimiia*, 1961, no. 8, p. 35-39.

New Routes to Cyano Complexes of Nickel(O) and Nickel(I).— **Cyano complexes of Ni(O) and Ni(I)** have been obtained by reactions carried out in molten potassium cyanide. When metallic nickel, **mercury(II) cyanide** and **potassium cyanide** in the respetcive molar proportions of 2:1:6 are heated together at 500° *in vacuo*, the major products are elementary mercury, potassium tetracyanonickelate(II) and potassium tetracyyanonickelate(O), $K_4[Ni(CN)_4]$. About one-quarter to one-third of the Ni remains unconverted, and a small amount of a paramagnetic Ni(I) compound is produced also. It is suggested that $K_4[Ni(CN)_4]$ arises from disproportionation of $K_4[Ni_2(CN)_6]$ in the presence of potassium cyanide. The Ni(O) complex has also been obtained by reaction between potassium tetracyanonickelate(II) and potassium cyanide at 480°. The paramagnetic Ni(I) complex, $K_3[Ni(CN)_4]$, has been obtained in 50-80% yield by reaction between elementary nickel, potassium tetracyanonickelate(II) and potassium cyanide in the respective molar proportions of 1:1:4 at 450-480°. — Samuel von Winbush, Ernest Griswold and Jacob Kleinberg. *American Chemical Society, Journal*, v. 83, Aug. 5, 1961, p. 3197-3200.

Rhodium Hexafluoride.— Recently ruthenium hexafluoride was prepared by burning Ru metal in a fluorine atmosphere in a liquid nitrogen cooled quartz reactor. The same method now has been applied successfully to the preparation of rhodium hexafluoride, the next member of this transition series. — Cedric L. Chernick, Howard H. Claassen, and Bernard Weinstock. *American Chemical Society, Journal*, v. 83, July 20, 1961, p. 3165-3166.

Compounds With the **Hexagonal Barium Titanate Structure.** — A number of compounds of the type $Ba(M,Ti)O_3$ where M = Ti^{3+}, V, Cr, Mn, Fe, Co, Ru, Rh, Ir, Pt have been prepared and are shown to have the hexagonal barium titanate structure. — J. G. Dickson, Lewis Katz, and Roland Ward. *American Chemical Society, Journal*, v. 83, July 20, 1961, p. 3026-3029.

Derivatives of Titanium With Compounds Having Bidentate Ligands. I. Reactions of **Titanium Tetrachloride.** II. Reactions of Titanium Alkoxides With **Methyl Acetoacetate.**— The reaction between titanium tetrachloride and acetyl acetone, ethyl acetoacetate, methyl acetoacetate and methyl salicylate has been studied and the compounds $TiCl_2(acac)_2$, $TiCl_2$(methyl acetoacetate)$_2$, $TiCl$(ethyl acetoacetate)$_2$ and $TiCl_2$(methyl salicylate)$_2$ have been isolated. The compound, $[Zr(acac)_3]Cl$, has also been prepared by the reaction between zirconium tetrachloride and acetyl acetone. By molecular weight measurements these compounds have been shown to be monomeric in nature rather than trimeric, as had been assumed by earlier workers. The reactions of **titanium alkoxides** (ethoxide, isopropoxide and butoxide) with methyl acetoacetate have been found to yield two types of derivatives—trialkoxy titanium monomethyl acetoacetate and dialkoxy titanium dimethyl acetoacetate. — D. M. Puri and R. C. Mehrotra. *Journal of the Less-Common Metals*, v. 3, no. 3, June 1961, p. 247-258.

CHEMISTRY—ORGANIC

• Reaction of Primary γ-Silicon-Containing **Acetylene Alcohols** With Thionyl Chloride.— Describes a method to obtain **silicon organic acetylene chloride** of the propalgyl type. Proposes a

process to produce secondary γ-silicon-containing acetylene alcohols, based on the reaction of Mg derivatives of silicon organic acetylene chloride with aldehydes. Five new silicon organic compounds were obtained and characterized. (*In Russian.*) Vzaimodeĭstvie pervichnykh γ-kremnesoderzhashchikh atsetilenovykh spirtov s khloristym tionilom. – N. V. Komarov, M. F. Shostakovskii, and L. N. Astaf'eva. *Zhurnal Obshcheĭ Khimii*, v. 31(93), no. 7, July 1961, p. 2100-2102.

• Investigations in the Lipide Field. VII. Synthesis of Some **Triglycerides** of Linseed and Soybean Oils. VIII. Synthesis of **α,β Dilinoleoine.**– (*In Russian.*) Issledovaniia v oblasti lipidov. VII. Sintez nekotorykh triglitseridov l'nianogo i soevogo masel. VIII. Sintez α,β dilinoleonia. – VII. T. K. Mitrofanova, E. N. Zvonkova, I. K. Sarycheva, S. P. Ivanshchenko, and N. A. Preobrazhenskiĭ. VIII. V. I. Shvets, L. V. Volkova, and N. A. Preobrazhenskiĭ. *Zhurnal Obshcheĭ Khimii*, v. 31(93), no. 7, July 1961, p. 2178-2183.

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• Investigations in the Diazocompound Domain. XIII. **Diazotization** of **Aromatic Amines** by Nitrite in Acetic Acid and Its Substitutes. XIV. Diazotization of Aromatic Amines by **Nitrite** in a Medium of Saturated Carboxylic Acids. XV. Diazotization of Aromatic Amines by Nitrite in Hydroxycarboxylic Acids.– (*In Russian.*) Issledovaniia v oblasti diazosoedineniĭ. XIII. O diazotirovanii aromaticheskikh aminov nitritom v uksusnoĭ kislote i ee zameshchennykh. XIV. O diazotirovanii aromaticheskikh aminov nitritom v srede predel'nykh karbonovykh kislot. XV. O diazotirovanii aromaticheskikh aminov nitritom v oksikarbonovykh kislotakh. – V. V. Kozlov and B. I. Belov. *Zhurnal Obshcheĭ Khimii*, v. 31(93), no. 7, July 1961, p. 2206-2221.

• Investigation in the Field of Formation of Polymethylene Ammonium Cycle. I. Synthesis and Transformations of Some Diphenylacetic Acid Esters.– A series of derivatives of **aminoethyl diphenylacetic esters** containing N-δ-chlorobutyls and N-δ-chloropentyl radials was synthesized. The kinetics of the transformation of these compounds into derivatives of **pyrrolidine** was studied. To the constants of cyclization of the homolog series of these compounds it is possible to add the Taft equation. (*In Russian.*) Issledovanie v oblasti obrazovaniia polimetilen-ammonievykh tsiklov. I. Sintez i prevrashcheniia nekotorykh efirov difeniluksusnoĭ kisloty. – S. G. Kuznetsov and D. V. Ioffe. *Zhurnal Obshcheĭ Khimii*, v. 31(93), no. 7, July 1961, p. 2289-2297.

• Synthesis of **Oxygen-Containing Disulfides** of the Fatty Series. – Eleven symmetrical O-containing disulfides of the aliphatic series were synthesized for the first time by the reaction of the corresponding chlorides with sodium disulfide. A previously unknown **ethyl-2-oxypropyldisulfide** was obtained by three different methods. **Di(1-methyl-2-metoxyethyl)** and **di[2-(2'-chloretoxy)-ethyl]-disulfide** are interesting as reagents, that is, as collectors for **cement Cu flotation.** (*In Russian.*) Sintez kislorodsoderzhashchikh disulfidov zhirnogo riada. – S. M. Gurvich. *Zhurnal Obshcheĭ Khimii*, v. 31(93), no. 7, July 1961, p. 2249-2252.

Reactivity Adds Versatility to Epoxy Oil.– New **polyepoxy glyceryl ester** has 14 reactive sites; holds promise as monomer and chemical intermediate. – *Chemical & Engineering News*, v. 39, no. 35, Aug. 28, 1961, p. 35-36.

• Terpenoids. XXV. **Structure** of Saussurea Lactone.– **Saussurea lactone** is identical with the product of pyrolysis of dihydrocostunolide. On cyclization in the presence of p-nitrobenzoic acid followed by hydrogenation it gives santanolide C. – A. Somasekar Rao, A. Paul Sadgopal, and S. C. Bhattacharyya. *Tetrahedron*, v. 13, no. 4, Aug. 1961, p. 319-323.

• Reactions of **t-Butyl Peresters.** III. Cuprous Bromide-Catalyzed Reaction of Peresters With **Ethers.**– Aliphatic and cyclic ethers react smoothly with t-butyl peracetate and t-butyl

perbenzoate at 67-90° in the presence of cuprous bromide. The first products of this reaction are the acyloxy derivatives of the ethers, which are unstable under the chosen experimental conditions and decompose to the corresponding carboxylic acids and unsaturated ethers. Thus, 2,3-dihydrofuran was prepared from 2-benzoyloxytetrahydrofuran in a 66% yield. The unsaturated ethers add t-butyl alcohol to give the corresponding acetals, this step being catalyzed by the carboxylic acid. This reaction is general for ethers containing two adjacent methylene groups, such as n-propyl and n-butyl ethers, tetrahydrofuran, and tetrahydropyran. Diethers, such as 1,4-dioxane and 1,2-dimethoxyethane, give more stable benzoyloxy derivatives, which decompose slowly on prolonged heating to give the expected acetals in low yield. – George Sosnovsky. *Tetrahedron*, v. 13, no. 4, Aug. 1961, p. 241-246.

• The **Radiolysis** of Cyclohexane. IV. Binary Mixtures in the Vapor Phase.– The variation of the hydrogen yield with the composition of binary gaseous mixtures containing **cyclohexane** and **benzene, cyclohexene,** or **propylene** is qualitatively similar to that in the liquid phase. The quantitative experimental data were tested against several possible reaction mechanisms and two mechanisms gave straight-line plots. – J. M. Ramaradhya and G. R. Freeman. *Canadian Journal of Chemistry*, v. 39, Sept. 1961, p. 1769-1775.

• The Preparation of Some **Mercapto Monosaccharides.**– Methyl 4,6-0-benzylidene-2-benzylthio-2-deoxy-α-D-altropyranoside and methyl 4,6-0-benzylidene-3-benzylthio-3-deoxy-α-D-altropyranoside have been prepared by the reaction of sodium benzylmercaptide with methyl 2,3-anhydro-4,6-0-benzylidene-α-D-allopyranoside and methyl 2,3-anhydro-4,6-0-benzylidene-α-D-mannopyranoside respectively. These two thio ethers were successfully reduced by sodium in liquid ammonia to methyl 2-deoxy-2-mercapto-α-D-altropyranoside and methyl 3-deoxy-3-mercapto-α-D-altropyranoside. An attempted replacement of the tosyl group in 1,2;5,6-di-0-isopropylidene-3-0-tosyl-α-D-glucofuranose by benzyl mercaptan was unsuccessful. – N. C. Jamieson and R. K. Brown. *Canadian Journal of Chemistry*, v. 39, Sept. 1961, p. 1765-1768.

• **Cyanocarbon Chemistry.**– Wide variety of nucleophiles either add to the double bond of **tetracyanoethylene** or displace one of its cyano groups, and these reactions have made possible the synthesis of many new polycyano compounds not accessible by other routes. (*In German.*) Cyankohlenstoff-Chemie. – T. L. Cairns and B. C. McKusick. *Angewandte Chemie*, v. 73, no. 15, Aug. 7, 1961, p. 520-525.

• Production of 1.2 Ethylene Dioxybenzol Derivatives. II. – Describes the **chloromethylation of ethylene dioxybenzol** and the transformation of **bis-chloromethyl derivatives** into the corresponding diol, dialdehyde and dicarbonic acid. (*In German.*) Darstellung von Derivaten des 1,2-Äthylendioxybenzols, 2. Mitt. – F. Dallacker and J. Bloemen. *Monatshefte für Chemie*, v. 92, no. 3, July 1961, p. 640-646.

• A New Procedure for the Production of **Trichloromethyl Organomercury Compounds.**– (*In Russian.*) Novyi metod sinteza trikhlormetil'nykh rtutnoorganicheskikh soedinenii. – O. A. Reutov and A. N. Lovtsova. *Akademiia Nauk SSSR, Doklady*, v. 139, no. 3, July 21, 1961, p. 622-625.

• **Polymerization of Formaldehyde** With Tri-n-alkyl Amines. – Polymerizations of formaldehyde were carried out at −80 to 0 C under vigorous agitation. All polymers obtained were melted within the range of 160-170 C in sealed capillaries, and their thermal degradation rate constants as first order at 222 C were 1.65%/min or more. **Intrinsic viscosities** in *p*-chlorophenol containing 2% in weight of alpha-pinene at 60 C were about 0.5-1.6. The toughness of films was excellent for having the higher viscosities. The polymers were reacted with acetic anhydride in the presence of pyridine, proving infrared-spectrophotometrically the terminal group to be hydroxyl-group. – Wakichi Fukuda and Hiroshi Kakiuchi. *Yokohama National University, Faculty of Engineering, Bulletin*, v. 10, Mar. 1961, p. 51-59.

• Studies on the Production of Terephthalic Acid. VI. **Solvent-Effect of o-Dichlorobenzene** on the Oxygen-Oxidation of *p*-Toluic Acid.– It is shown that *o*-dichlorobenzene has a special solvent-effect on the oxygen-oxidation of **p-toluic acid.** A mixture of trichlorobenzenes which was obtained by the

dehydrochlorination of benzenehexachloride also promoted the oxidation of *p*-toluic acid in the presence of the Co-salt, though the promoting effect was weaker than that of *o*-dichlorobenzene. The promoting effect of *o*-dichlorobenzene is at least partly due to the increase of the hydrogen-abstracting activity of free chlorine radicals, which are formed by the scission of C-Cl bonds in dichlorobenzene molecules during oxidation. (*In Japanese.*) – Nobuto Ohta. *Government Chemical Industrial Research Institute, Tokyo, Reports*, v. 56, June 1961, p. 221-224.

Formation of **Hydrogen Peroxide** in the Gaseous Oxidation of Isopropyl Alcohol.– The **gaseous oxidation** of **isopropyl alcohol** has been studied in a flow system at temperatures between 350° and 450° at atmospheric pressure. Chemical analyses of the products have been made and the effects of temperature, reactant composition and surface conditions are recorded, particularly with reference to the formation and recovery of hydrogen peroxide. – A. R. Burgess. *Journal of Applied Chemistry*, v. 11, July 1961, p. 235-243.

• Acid **Hydrolysis** of Organic Fluorophosphorus Compounds. – Acid hydrolysis of **dimethoxy-, methoxyethyl-** and **diethyl phosphoryl fluorides** has been studied in different concentrations of hydrochloric acid at 0 and 25 C. – Gunnar Aksnes and Svein Ivar Snaprud. *Acta Chemica Scandinavica*, v. 15, no. 3, 1961, p. 457-462.

Derivatives of Fluorene. XV. **Fluorofluorenes.** IV. XVI. **N-9-Fluorenylmaleamic Acids** and **Maleimides.** – XV. Moses J. Namkung and T. Lloyd Fletcher. XVI. Hsi-Lung Pan and T. Lloyd Fletcher. *Journal of Organic Chemistry*, v. 26, July 1961, p. 2243-2247.

• The **Oxidation** of **n-Butane** in the Gaseous and Liquid Phases.– The induction period of the process in **gaseous phase** is considerably longer than in the **liquid phase,** and the reaction velocity, upon the completion of induction period, is the same. (*In Russian.*) Okislenie *n*-butana v gazovoi i zhidkoi faze. – E. A. Bliumberg, G. E. Zaikov, and N. M. Emanuel. *Akademiia Nauk SSSR, Doklady*, v. 139, no. 1, 1961, p. 99-101.

• Alkylation of Tetrahydrofuran by **Ethylene.**– In this work is shown for the first time the possibility of **alkylation** of **tetrahydrofuran** by ethylene at high temperatures and pressures. (*In Russian.*) Alkilirovanie tetragidrofurana etilenom. – N. I. Shuikin and B. L. Lebedev. *Akademiia Nauk SSSR, Doklady*, v. 139, no. 1, 1961, p. 131-133.

• **Thermal Condensation** of Dichlorosilane With **Chlorobenzene.**– The process is complex and in the reaction products, **phenyldichlorosilane** occurs along with diphenyldichlorosilane, phenyltrichlorosilane, benzene, and trichlorosilane. The yield of reaction products primarily depends on temperature. (*In Russian.*) O termicheskoi kondensatsii dikhlorsilana s khlorobenzolom. – K. A. Andrianov, V. I. Savushkina, S. A. Golobtsov, and B. A. Charskaia. *Akademiia Nauk SSSR, Doklady*, v. 139, no. 1, 1961, p. 95-98.

• A Contribution to the Study of **Bis-Duroquinone-Nickel (O)** and **Cyclooctatetraene-Duroquinone-Nickel (O).**– Describes the production, properties and **structure** of these two complexes which must be understood as "sandwich" compounds of the nonvalent Ni. In the complex, cyclotetraene is connected to the Ni atom in a troughlike way. Suggestions are given concerning the meaning of the relative difference of the ligand energies and the metal orbital energies in relation to the stability of metalloid complexes. (*In German.*) Zur Kenntnis von Bis-durochinon-nickel(O) und Cyclooctatetraen-durochinon-nickel(O). – G. N. Schrauzer and H. Thyret. *Zeitschrift für Naturforschung*, v. 16b, June 1961, p. 353-356.

• Use of **Tritium** in Organic Chemistry and **Biochemistry.**– Tritium, due to its soft radiation, its great isotope effects and its low cost, occupies a special position among radioactive isotopes. This results in particular possibilities and limits of the use of tritium. In spite of developments in the field of direct **labeling,** the classic method of labeling by chemical synthesis is still of interest. Progress has been achieved in the analysis of tritium-containing compounds. In the field of autoradiography, the high resolving power of tritium makes this isotope interesting above all for biochemical investigations too (insight into cellular and subcellular spaces). (*In German.*) Das Arbeiten mit Tritium in der organischen Chemie und Biochemie. – H. Simon. *Angewandte Chemie*, v. 73, no. 14, July 21, 1961, p. 481-487.

Sucrose Ether- and Ester-Linked Surfactants.– Alkylsucroses, prepared *via* sodium sucrate in dimethyl sulfoxide (DMSO) and higher alkyl bromides, are believed to be the first **sugar-based surfactants** which are at least equivalent to the best anionics and nonionics in cloth detergency on the basis of laboratory data; they were also active lime-soap dispersants. Another **ether-linked** type, the (3-alkoxy-2-hydroxypropyl) and (2-hydroxyalkyl) sucroses, derived from glycidyl ethers or olefin oxides, although second in **detergency** to the first type, included exceptional nonionic lathering agents. t-Dodecylbenzylsucrose, from dodecylbenzyl chloride, was also a rather active detergent and lime-soap dispersant. Less active but easily prepared sucrose half-esters from alkenylsuccinic anhydrides were described. – V. R. Gaertner. *American Oil Chemists' Society, Journal*, v. 38, Aug. 1961, p. 410-418.

• The Reaction of **Benzoyl Chloride** and **Ethyl Benzoate** With Some **Alkali Metal Salts of Fluorene.**– In hydrocarbon or ether solvents, the sodium or potassium salt of fluorene or of 9-benzoylfluorene reacts with an equimolar amount of benzoyl chloride to form 9,1′-benzoyloxybenzylidenefluorene. The reaction of equimolar quantities of the lithium salt of fluorene or of 9-benzoylfluorene and benzoyl chloride in ether solvents gives rise to a mixture of 9,9-dibenzoylfluorene and 9,1′-benzoyloxybenzylidenefluorene, but in hydrocarbon solvents produces only 9,9-dibenzoylfluorene. Only 9-benzoylfluorene is isolated from the reactions of the monometal salts of fluorene or of 9-benzoylfluorene with ethyl benzoate. – G. W. H. Scherf and R. K. Brown. *Canadian Journal of Chemistry*, v. 39, Aug. 1961, p. 1613-1618.

• Studies on Cyclohexane Derivatives. II. Preparation and Chemical Proof of the **Configuration** of the Two 4-Methylcyclohexanecarboxylic Acids.– The preparation of pure low-melting **4-methylcyclohexanecarboxylic acid** (m.p. 30.5-31.5°) is described for the first time. By chemical means it is proved that low-melting 4-methylcyclohexanecarboxylic acid possesses the *cis*-configuration and the high-melting isomer the *trans*-configuration. For this purpose these acids were converted into *cis*- and *trans*-4-dimethylcyclohexane, respectively, using reactions which take place without any change of configuration at the cyclohexane nucleus. The configuration of these two hydrocarbons has been proved in the first paper of this series. – H. van Bekkum, et al. *Recueil des Travaux Chimiques des Pays-Bas*, v. 80, July 1961, p. 595-607.

Unsymmetrically Substituted **Melamines.**– Unsymmetrically substituted melamines have been prepared from **cyanuric chloride** by successive reaction with three different amines. The procedure is quite general. Most of these new compounds are liquids and were found to possess a rather high degree of **thermal stability.** – J. Robert Campbell and Roger E. Hatton. *Journal of Organic Chemistry*, v. 26, Aug. 1961, p. 2786-2789.

Sulfanilamidopyrimidines. I. 4-Sulfanilamidopyrimidines by **Heterocyclic Nucleophilic Displacements.**– Facile displacement of a methylsulfonyl group by sulfanilamide anion provided a new type of synthesis of the highly antibacterial **4-sulfanilamido-6-methoxy-pyrimidine.** Nucleophilic displacements involving other groups and other sulfonamide anions have been investigated. A new route to 4-sulfanilamidopyrimidine proceeded through the previously unreported 4-sulfanilamido-6-chloropyrimidine. – R. G. Shepherd, W. E. Taft, and H. M. Krazinski. *Journal of Organic Chemistry*, v. 26, Aug. 1961, p. 2764-2769.

• Peroxide Desulfurization of **Thioureas.**– Investigation of the **hydrogen peroxide desulfurization** of thioureas to the corresponding ureas has led to a convenient method for synthesizing intermediates which lead to physiologically active **uracils.** The method has been extended to the synthesis of **5-ureidouracils.** Some of the limitations of the reaction are discussed. – Max J. Kalm. *Journal of Organic Chemistry*, v. 26, Aug. 1961, p. 2925-2929.

The Air Oxidation of **Trialkylboranes.**– Study of the **air oxidation** of trialkylboranes shows that the first boron-carbon bond oxidizes faster than the second and the second much faster than the third; the presence of water prevents the oxidation of the third bond. – Stanley B. Mirviss. *American Chemical Society, Journal*, v. 83, July 20, 1961, p. 3051-3056.

N,N'-Disubstituted-1-amino-7-imino-1,3,5-cycloheptatrienes, a Non-Classical Aromatic System.– N,N'-Disubstituted-1-amino-7-imino-1,3,5-**cycloheptatrienes** are stable, highly colored compounds that are readily accessible from the **tetrafluorocycloheptadienes** derived from tetrafluoroethylene and cyclopentadiene. – W. R. Brasen, H. E. Holmquist, and R. E. Benson. *American Chemical Society, Journal*, v. 83, July 20, 1961, p. 3125-3135.

• Synthesis of **Ammonium Sulfamate** From **Ammonium Nitrilosulfonate.**– It was previously reported that $NH_4SO_3HN_2$ was produced in a high yield by heating $(NH_4SO_3)_2NH$ at 200-250 C under an ammonia pressure of 30-50 atm. It has now been found that this compound can also be produced from $(NH_4SO_3)_3N$ nearly in the same yield. When $(NH_4SO_3)_3N$ was heated for 30 min at 210-250 C under an ammonia pressure of 30 atm., the product contained 80% of $NH_4SO_3NH_2$. It has also been found that, when heated under ammonia pressures, $(NH_4SO_3)_3N$ begins to change into $(NH_4SO_3)_2NH$ at about 150 C. The amount of $(NH_4SO_3)_2NH$ formed increases with the increase in temperature up to 170-190 C, and above this temperature range the amount decreases rapidly. (*In Japanese.*) – Yukio Ito and Etsuro Kobayashi. *Government Chemical Industrial Research Institute, Tokyo, Reports*, v. 56, July 1961, p. 263-265.

The *ortho*-Claisen Rearrangement. III. The Rearrangement of β-Alkylallyl Aryl Ethers.– A series of **β-alkylallyl phenyl ethers** and **β-alkylallyl p-methoxyphenyl ethers,** in which the steric requirements of the alkyl group varied greatly have been synthesized. The rates of rearrangement of these ethers were determined and it was found that all the β-alkylallyl phenyl ethers reacted at nearly the same speed. The same result was obtained with the series of β-alkylallyl *p*-methoxyphenyl ethers. – William N. White and Bruce E. Norcross. *American Chemical Society, Journal*, v. 83, Aug. 5, 1961, p. 3265-3269.

• On the **Electrical Conductivity** of the Organic **Thin Films:** Perylene, Coronene and Violanthrene.– The resistivity observed with the sandwich-type cell, **perylene;** 10^{18}~^{19} Ωcm., **coronene;** 10^{17}~^{18} Ωcm., and **violanthrene;** 10^{14} Ωcm., is in quite good agreement with that of the bulk specimen. However, a great difference was found between the resistivities of the sandwich-type and the surface-type cells, perylene; 10^{18} Ωcm., coronene; 10^{12}~^{13} Ωcm., and violanthrene; 10^{9} Ωcm. – Hiroo Inokuchi, Haruo Kuroda, and Hideo Akamatu. *Chemical Society of Japan, Bulletin*, v. 34, no. 6, June 1961, p. 749-753.

CHEMISTRY—PHYSICAL (ORGANIC AND INORGANIC)

• Liquid-Covered Active **Aluminum Oxide** as a Stationary Phase in **Gas Chromatography.**– Two new very selective separating liquids: ethylene glycol-bi(propionitrile)-ether and glycerine-tri(propionitrile)-ether, are given. These liquids are as selective as β,β'bis(propionitrile)-ether, but permits higher working temperatures (140 and 170 C). The separating efficiency and loading capacity of columns of different diameters between 1 and 10 cm are indicated. (*In German.*) Flüssigkeitsbedecktes aktives Aluminiumoxyd als stationäre Phase in der Gaschromatographie. – I. Halász and E. E. Wegner. *Zeitschrift für Analytische Chemie*, v. 181, 1961, p. 382-384.

• Calculation of Enthalpy of **Gaseous Mixtures.**– Two new methods are proposed. The first utilizes pseudoacentric factors, pseudocritical constants, and generalized **enthalpy functions** for pure fluids. The second method uses virial equations of state of mixtures and recent correlations for cross-coefficients. – Jerome Brewer and J. M. Geist. *Journal of Chemical and Engineering Data*, v. 6, no. 3, July 1961, p. 405-408.

• Solid-Liquid Phase Equilibria for Mixtures of **Lithium, Sodium,** and **Potassium Carbonates.**– Reports the results of studies for the Li_2CO_3-Na_2CO_3, Li_2CO_3-K_2CO_3, and Li_2CO_3-Na_2CO_3-K_2CO_3 systems undertaken to establish accurately the **liquid-solid phase equilibria** in mixtures. – George J. Janz and Max R. Lorenz. *Journal of Chemical and Engineering Data*, v. 6, no. 3, July 1961, p. 321-323.

• Effects of the Aldehydes on **Tertiary Alcohols.** I. General: **Condensation** Under the Action of Boron Fluoride.– Formic aldehyde condenses under the effect of **boron fluoride** with the tertiary alcohols possessing one H atom sufficiently mobile, due to the hyperconjugation, on the carbon in α as compared with the hydroxyl carbon. The primary process is the Prins reaction followed by different secondary phenomena. The other **aldehydes** condense only with tertiary alcohols having a second function: the primary process then is hemiacetadization. (*In French.*) Action des aldéhydes sur les alcools tertiaires. I. Généralités; condensations sous l'action du fluorure de bore. – René Lombard and Michel Asfazadourian. *Société Chimique de France, Bulletin*, 1961, no. 7, July, p. 1311-1316.

• The Reaction of **Antimoniuretted Hydrogen** With Silver Nitrate Solutions.– Shows by polarographic method that the reaction of H_3Sb in amounts of the order of 1/10 mg with a diluted solution of **$AgNO_3$** produces some Sb^{3+} in the insoluble form, a small quantity being solubilized owing to the acidity of the medium. Silver antimonide is also found, but to a lesser extent. (*In French.*) Sur la réaction de l'hydrogène antimonié avec les solutions de nitrate d'argent. – Louis Vignoli, Bernard Cristau, and Fernand Gouézo. *Société Chimique de France, Bulletin*, 1961, no. 7, July, p. 1335-1337.

• The Use of Nickel-63 as a **Radioactive Indicator.**– This use of **Ni-63** requires the separation of Co 58 formed simultaneously by the ^{58}Ni (n, p)^{58} reaction. The β-radiation of 67 keV was measured with a liquid scintillation device with 60% efficiency. (*In French.*) Sur l'emploi du nickel 63 comme indicateur radioactif. – Jean-Pierre Adloff and Madeleine Bacher. *Société Chimique de France, Bulletin*, 1961, no. 7, July, p. 1321-1323.

The Sorption of **Hydrogen** by **Barium Getters.**– Velocity of surface adsorption is studied at low pressures and its dependence on surface area, pressure, and temperature is considered. The velocity of diffusion is examined for pressures and film thicknesses which are near to those in current industrial use. In this case, particular attention is paid to the influence of temperature, as well as to the influence of parameters such as temperature of condensing walls, residual pressure at evaporation, and time of flashing of the getter, all of which are of considerable practical interest. – P. Della Porta and S. Origlio. *Vacuum*, v. 11, no. 1, Feb. 1961, p. 26-31.

Uranium Monosulfide. II. Mass Spectrometric Study of Its **Vaporization.**– A study of the vapor effusing from a W effusion cell containing uranium monosulfide has been performed with the aid of a time-of-flight mass spectrometer. – E. David Cater, E. G. Rauh, and R. J. Thorn. *Journal of Chemical Physics*, v. 35, Aug. 1961, p. 619-624.

Calculation of **Depolarization Ratios, Anisotropies,** and Average Dimensions of **n-Alkanes.**– General scheme is outlined for the calculation of the anisotropy of the polarizability and the depolarization ratio for alkane chains. Computed results are given for these quantities, and also for the mean-square end-end distance and the mean-square radius for chains of up to 10 carbon atoms. The effects of various weighting-factor approximations, of excluded volume, of temperature, and of *trans-gauche* energy difference are discussed. The theoretical and experimental depolarization ratios are compared and discussed. – Richard P. Smith and Earl M. Mortensen. *Journal of Chemical Physics*, v. 35, Aug. 1961, p. 714-721.

Effect of Pressure on the **Spectrum of Ruby.**– The effect of pressure has been measured on the spectrum of ruby, both parallel and perpendicular to the *C* axis to 120 kbar. From these data, it is possible to calculate the change in crystal field strength *Dq* in interelectronic repulsion *B* and in trigonal field distortion (-3/2 *K*). – D. R. Stephens and H. G. Drickamer. *Journal of Chemical Physics*, v. 35, Aug. 1961, p. 427-429.

Paramagnetic Resonance Absorption of the **Dimesitylmethyl Radical.**– Nearly 300 of the 910 theoretical lines have been resolved and analyzed in terms of the **coupling constants** of the various nuclear species. A spin-density distribution throughout the molecule has been deduced from the measurements and is compared with recent theoretical calculations. – D. B. Chesnut and G. J. Sloan. *Journal of Chemical Physics*, v. 35, Aug. 1961, p. 443-444.

Diamond-Graphite Equilibrium Line From Growth and Graphitization of Diamond.– Diamond growth occurs at high temperatures and pressures in the presence of certain molten metals which serve as solvent catalysts. The **zones of pressure and temperature** in which diamond growth occurs have been determined for a number of metals. – F. P. Bundy, H. P. Bovenkerk, H. M. Strong, and R. H. Wentorf, Jr. *Journal of Chemical Physics*, v. 35, Aug. 1961, p. 383-391.

Atomic Polarization. II. Vibrational Polarization of **Liquids.** III. Vibrational Polarization Terms Associated With Forbidden Transitions in **Polyatomic Molecules.** IV. Temperature Dependence of Vibrational Polarization of **Gases.** V. Normal Mode Polarizability and the Additivity of the **Vibrational** Polarization. – II-IV. Karl H. Illinger and Charles P. Smyth. V. Karl H. Illinger. *Journal of Chemical Physics*, v. 35, Aug. 1961, p. 392-420.

Radiation Induced **Chemisorption** of **Oxygen** on **Chromia.** – M. Nachman, I. Maxim, and T. Braun. *Physics and Chemistry of Solids*, v. 20, nos. 3-4, Aug. 1961, p. 307-314.

The Susceptibility of NO in **β-Quinol Clathrates.**– **Susceptibility** measurements on polycrystalline samples **between 1 K and room temperature** are described. – H. Meyer. *Physics and Chemistry of Solids*, v. 20, nos. 3-4, Aug. 1961, p. 238-240.

Stereochemistry of Hot Hydrogen Displacement at sp^3 **Carbon-Hydrogen Bonds.**– The stereochemistry of the **displacement** of hydrogen by hot hydrogen atoms has been studied at an sp^3 carbon atom in a gaseous molecule. The system used was the reaction of recoil tritium, from the **nuclear reaction** $He^3(n,p)H^3$, with optically active 2-butanol. – Michael Henchman and Richard Wolfgang. *American Chemical Society, Journal*, v. 83, July 20, 1961, p. 2991-2996.

Mechanisms of Hot Hydrogen Atom Displacement Reactions With Alkanes.– The reaction mechanisms of **hot hydrogen atoms** with **alkanes** have been studied. Recoil tritium from nuclear reaction was used as the source of hot hydrogen and **iodine or oxygen** served as **scavengers** to suppress interference from the minority of tritium atoms that reach thermal energies. – David Urch and Richard Wolfgang. *American Chemical Society, Journal*, v. 83, July 20, 1961, p. 2982-2991.

Alumina: Catalyst and Support. X. Modification of Alumina by Bases. Mechanism of **Dehydration of Menthol and Neomenthol.** XI. Mechanism of Dehydration of Aliphatic Alcohols and the Formation of **Cyclopropanes** During Dehydration. – X. Herman Pines and C. N. Pillai. XI. C. N. Pillai and Herman Pines. *American Chemical Society, Journal*, v. 83, Aug. 5, 1961, p. 3270-3279.

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DC Motor Control. IV. Accessory Devices and Controller Construction. – J. Ronald Wickey. *Machine Design*, v. 33, Aug. 31, 1961, p. 104-111.

• Calculation of **Voltage Controlling Transductors** as Adjusting Members in Controlled Installations.– From the load characteristics relationships are determined and these are used for defining the complete voltage control range which is the basis for the design of the transductors. Particular consideration is given to reserves which should be available for corrective action in order to compensate for the effect of disturbances. The correlations between **voltage control range, output current** and the performance of various types of **transductor chokes** are shown. The method of design is illustrated by three typical examples of application. (*In German.*) Die Berechnung spannungssteuernder Transduktoren als Stellglieder in geregelten Anlagen. – H. Winkler. *Regelungstechnik*, v. 9, July 1961, p. 273-277.

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ELECTROCHEMISTRY

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Feedback Amplification Improves Hall-Effect Multipliers.– Two major shortcomings of the **Hall-effect multiplier** are overcome by using a feedback amplifier to drive the field coil current in phase with the input signal and by adding a d-c component to the field coil signal. – R. A. Greiner. *Electronics*, v. 34, no. 34, Aug. 25, 1961, p. 52-55.

Measuring **Transient Light** With Vacuum Phototubes.– When using **vacuum phototubes** to measure transient light, precautions are required to achieve a linear current-light relationship. Discusses the problems involved. – Harold E. Edgerton and Richard O. Shaffner. *Electronics*, v. 34, no. 34, Aug. 25, 1961, p. 56-57.

A Forty-Position, Six-Pole Microwave Stripline Switch for Electromechanical **Antenna-Array Scanning.**– Design and development of a stripline microwave switch used for scanning a multielement antenna array. The switch was developed as a part of a high-gain directional antenna system successfully orbited in the Agena satellite program. The **stripline techniques** used are described, as well as the development of **non-contacting capacitive couplers** to provide for continuous r-f transmission during the switching cycle. The switch has been subjected to extensive environmental testing with special emphasis on the problem of **"cold welding"** of metal parts exposed to the extreme vacuum of space. Some of the techniques investigated are reviewed together with a specific solution for lubricating the moving parts within the switch. – James M. Elam. Paper from "Proceedings of the 5th Mil-E-Con National Convention on

Military Electronics 1961 Conference, June 26-28, 1961, Washington, D. C.", Institute of Radio Engineers, New York. 1961, p. 353-357. (UG485 In7n5)

Automatic Tracking Considerations for Ballistic Targets.– The problems encountered during the various phases of automatic tracking of a **ballistic target** have been discussed. Analyses of the dynamics of several types of ballistic targets have been presented. The operation of a **precision tracking radar** has been illustrated with a brief description for each phase of operation. Various techniques which can be used to overcome the unique problems of tracking a ballistic target were demonstrated. The advantages and disadvantages of these techniques, together with the problems inherent in their synthesis and operation, have been discussed. – Stephen Adelman and Stanley M. Shinners. Paper from "Proceedings of the 5th Mil-E-Con National Convention on Military Electronics 1961 Conference, June 26-28, 1961, Washington, D. C.", Institute of Radio Engineers, New York, 1961, p. 416-424. (UG485 In7n5)

Our new format should help you scan the page quickly. Boldface clue words identify subject matter. Titles appear unchanged at the beginning of each abstract.

Limitations on Dynamic Range and **Multi-Target Resolution** for a Search or **Track Radar.**– Distortion in a radar transmitter or receiver deteriorates radar information with respect to adjacent targets differing significantly in radar cross section. The principal sources of the **time and frequency domain distortion** are discussed and quantitatively evaluated in terms of performance by means of the radar **"uncertainty function".** – William L. Rubin and Julius V. DiFranco. Paper from "Proceedings of the 5th Mil-E-Con National Convention on Military Electronics 1961 Conference, June 26-28, 1961, Washington, D. C.", Institute of Radio Engineers, New York. 1961, p. 425-429. (UG485 In7n5)

Breadboard COLIDAR (**Coherent Light Detecting and Ranging**) **System.**– The development of an **optical superhetrodyne** for use in the COLIDAR system awaits a CW LASER with frequency within a few hundred megacycles of the ruby line and/or the development of a **phototube** with a **traveling wave** structure which will pass IF frequencies in the microwave region. – M. L. Stitch, F. J. Meyers, J. H. Morse, and E. J. Woodbury. Paper from "Proceedings of the 5th Mil-E-Con National Convention on Military Electronics 1961 Conference, June 26-28, 1961, Washington, D. C.", Institute of Radio Engineers, New York. 1961, p. 279-284. (UG485 In7n5)

Satellites Go Commercial--for **Communications.**– Bell System proposes a preliminary plan involving 26 ground terminals and active satellites in somewhat random polar orbits, 3,000 miles high. Broadband channels, each accommodating 600 telephone circuits, would be provided. – H. E. Weppler. *Electrical Engineering*, v. 80, Aug. 1961, p. 569-574.

° Amplitude Distortion in **Transistor Feedback Amplifiers.**– Attention is directed to the problem of calculating the **distortion components** of the collector current of a transistor (in the common-emitter connection) which is part of a feedback amplifier. Although the calculation process involves an approximation which is dependent on the input signal level, consideration is given to amplitude distortion arising both in the input circuit and in the **forward transfer characteristic.** – J. H. Mulligan, Jr. *Communication and Electronics*, 1961, no. 55, July, p. 326-335.

Low-Frequency Parametric Amplification by Means of an Induction Machine.– Although **parametric amplifiers** are commonly considered as components for use of microwave frequencies, there is no inherent frequency limitation. The gain and bandwidth relationships for a negative-resistance parametric amplifier can be used at a **60-cycle** signal frequency. – R. A. Elco. *Electrical Engineering*, v. 80, Aug. 1961, p. 600-604.

Crystal-Stabilized **Tunnel-Diode Oscillators.**– Theory and design procedure for **crystal-controlled** tunnel diode oscillator that operates at 40 meg. and has frequency variation of 7.5 p.p.m/°C.

– John J. Nagle. *Electronics*, v. 34, no. 35, Sept. 1, 1961, p. 40-42.

a ° **Measuring Amplifiers.**– In the construction of measuring amplifiers, special stress has to be laid on neutral point stability, acoustic sensitivity, good linearity of the characteristic curve, and high amplifying constancy. By means of countercoupling and, in certain instances, by the introduction of an integration link in an amplifier cascade, considerable improvements can be achieved. (*In German.*) Messverstärker. – Hellmut Schneider. b *VDI Zeitschrift*, v. 103, no. 23, Aug. 1961, p. 1163-1168.

° Some Possible Uses of Single Sideband Signals in **Formant-Tracking Systems.**– An amplitude-modulated **single-sideband waveform** can be separated into two parts, viz., an amplitude or "envelop" term, and a frequency-modulation term. Some existing proposals for the use of the frequency-modulation part in speech compression schemes have been investigated, and al- c though these schemes were found to be fallacious, some results having possible application to speech format tracking were obtained. – E. Colin Cherry and V. J. Phillips. *Acoustical Society of America, Journal*, v. 33, Aug. 1961, p. 1067-1077.

A Multiplex Pulse-Height Recorder and Analyzer.– A system intended for the analysis, processing, and storage of pulse-height and time data originating from chemically prepared samples is d described. – A. A. Wydler. *U. S. Atomic Energy Commission, UCRL*-9720, May 26, 1961, 19 pp. (UF767 U3u Contin.)

ENGINEERING ECONOMICS

e ° **World Oil Demand in 1961** Will Rise to Over 23 Million Barrels Daily.– Trends in **petroleum consumption,** estimated world consumption, statistics on international oil trade, and flow of the world's oil. – *World Petroleum*, v. 32, Sept. 1961, p. 46-48.

f ° **Russia's Oil Drive.**– Russia's "dumping" of crude oil on the international market has a serious effect on the smaller, crude-producing nations whose economies depend on crude oil products, especially Arab countries. – Gordon W. Reed. *World Petroleum*, v. 32, Sept. 1961, p. 54-56.

Expansion Estimating.– System can be a valuable aid in product and process cost studies. Article reviews unique conceptual approach and **simplified statistical methods** used to g solve problems as they were encountered. – R. M. Waddell. *Chemical Engineering Progress*, v. 57, Aug. 1961, p. 51-56.

° Economic Factors in **Business Planning.**– Balanced planning requires impartial application of inter-disciplinary skills, check on adequacy of separate department, division plans; current opinion trends need weighing. – Murray L. Weidenbaum. *Ad-* h *vanced Management*, v. 26, July-Aug. 1961, p. 28-31.

Decision Models for Inventory Management.– Provides a guide for use in the study of **inventory problems** which will lead to the development of ordering rules for effective inventory control, based on a mathematical inventory model and appropriate data on costs, demand, and lead time necessary to solve the models. – Robert B. Fetter and Winston C. Dalleck. 123 pp. i 1961. Richard D. Irwin, Inc., Homewood, Illinois. (HF5681.S8 F4.d)

Petrochemicals: What's Ahead.– Discusses factors underlying recent growth with its consequent **industry overcapacity?** Predicts future situation. – Roland A. Labine. *Chemical Engineering*, v. 68, Sept. 4, 1961, p. 113-130. j

FLUID MECHANICS

Magnetohydrodynamic Shock Structure Without Collisions.– The internal structure of a magnetohydrodynamic shock is examined under the condition that there are no **collisions** among k the **plasma particles.** The equations to be solved are the collisionless, steady Boltzmann equations for ions and electrons

coupled with Maxwell's equation for the fields (a self-consistent system). There is one space variable x and all quantities are prescribed constant as $x = -\infty$. Under appropriate conditions at $-\infty$, e.g., no transverse magnetic field, low ion pressure, and Alfvén-Mach number roughly less than 2, the state at $+\infty$ has oscillating fields, density, etc. The length scale is a mean phase length. Thus a change of state is possible without collisions. The theory is based on an asymptotic development in the ion-to-electron mass ratio and is valid over distances that are comparable to or even large compared to the wavelength of the oscillation but small compared to the ion Larmor radius. The electrons are adiabatic. – Cathleen S. Morawetz. *Physics of Fluids*, v. 4, no. 8, Aug. 1961, p. 988-1006.

Transient **Magnetohydrodynamic Duct Flow.**– Parallel flow of an electrically conducting viscous incompressible fluid in a rectangular duct with transverse magnetic field is considered. The walls of the duct which are parallel and perpendicular to the imposed magnetic field are taken to be nonconducting and perfectly conducting, respectively. Assuming the fluid to be at rest at the initial moment, exact solutions for the velocity and magnetic field components are obtained in the form of convolution integrals taking the longitudinal pressure gradient as an arbitrary given function of time. Later, taking a step function for the pressure gradient, these expressions are integrated. For this case, the effect of the strength of the imposed magnetic field on the development behavior of the flow is studied. It is found that except for very large magnetic fields, the flows are over damped. – T. S. Lundgren, B. H. Atabek, and C. C. Chang. *Physics of Fluids*, v. 4, no. 8, Aug. 1961, p. 1006-1011.

Film Cooling With Multiple Slots and Louvers. I. Multiple Continuous Slots. II. Multiple Rows of Discrete Louvers.– Experimental results are presented for film cooling of an adiabatic plate downstream of one to ten slots and two to twenty rows of discrete punched louvers in a subsonic **turbulent flow** under zero pressure gradient. The adiabatic wall temperatures downstreams of the last equivalent slot were measured and correlated in terms of the flow parameters, equivalent slot number and slot spacing, and distances downstreams of the last equivalent slot. – I. J. H. Chin, S. C. Skirvin, L. E. Hayes, and F. Burggraf. II. F. Burggraf, J. H. Chin, and L. E. Hayes. *ASME, Transactions, Series C, Journal of Heat Transfer*, v. 83, no. 3, Aug. 1961, p. 281-292.

An Integral Treatment of Two-Phase Boundary Layer in **Film Condensation.**– By using the integral method, the task of solving the complicated **two-phase boundary-layer** differential equations in laminar-film condensation has been reduced to the simple work of solving an algebraic equation. – J. C. Y. Koh. *ASME, Transactions, Series C, Journal of Heat Transfer*, v. 83, no. 3, Aug. 1961, p. 359-362.

• Studies on the Characteristics of **Axial-Flow Pumps.** I. General Tendencies of the Characteristics of Pumps. II. Analytical Method of Determining the Discharge-Theoretical Head Characteristics. III. **Flow** Before and Behind Impellers of Several Different Types. IV. Comparison Between Theory and Experimental Results. V. Experimental Investigation on the **Impeller Performance.** VI. Experimental Studies on the Hydraulic Losses. – Tomitaro Toyokura. *Bulletin of JSME*, v. 4, no. 14, May 1961, p. 287-340.

• **Mass Transfer** Through **Laminar Boundary Layers**--3a. Similar Solutions of the b-Equation When $B = 0$ and $\sigma \geqq 0{\cdot}5$. – Using a form of expansion first suggested by Merk, series are given for evaluating accurately the "wall gradient" (b'_0/B) for the case when no mass flows through the phase boundary. – H. L. Evans. *International Journal of Heat and Mass Transfer*, v. 3, no. 1, Aug. 1961, p. 26-41.

• Theory of the Steady **Laminar Buoyant Flow** Above a Line **Heat Source** in a Fluid of Large Prandtl Number and Temperature-Dependent Viscosity. – D. B. Spalding and R. G. Cruddace. *International Journal of Heat and Mass Transfer*, v. 3, no. 1, Aug. 1961, p. 55-59.

• The Development of **Axial Blowers** and Their Methods of Control in Industry.– **Control methods** used for these machines are briefly described and compared, and the advantages of control by adjustment of the stator blades are illustrated by a few examples. – A. Stoeckicht. *Sulzer Technical Review*, v. 43, no. 1, 1961, p. 17-28.

• Prediction of Symptoms of Cavitation.– Analysis which indicates some of the basic problems in cavitation and which may permit the **prediction of cavitation** characteristics of hydraulic equipment is presented. Some experimental results are discussed and are compared with the results of the analysis. – Robert B. Jacobs. *U. S. National Bureau of Standards, Journal of Research, Section C, Engineering and Instrumentation*, v. 65C, no. 3, July-Sept. 1961, p. 147-156.

• Energy Spectrum of a **Turbulent Flow** of **Incompressible Fluid.**– An equation is derived for the energy spectrum in the equilibrium range. (*In Russian.*) O spektre energii turbulentnogo potoka neszhimaemoi zhidkosti. – E. A. Novikov. *Akademiia Nauk SSSR, Doklady*, v. 139, no. 2, 1961, p. 331-334.

Fan Performance Indicators.– A basic aid to **selection and design of fans;** correlation of performance data to satisfy requirements without resorting to rule of thumb. – N. J. Lipstein. *Machine Design*, v. 33, Aug. 31, 1961, p. 118-120.

The Stability of **Viscous Flow** Between Rotating Cylinders in the Presence of a Magnetic Field. II.– Results are given for the case when the **two cylinders** rotate in opposite directions with equal angular velocities. – S. Chandrasekhar and Donna D. Elbert. *Royal Society, Proceedings*, v. 262, ser. A, Aug. 8, 1961, p. 443-454.

• **Flow-Rate Measurements** With **Orifice Plates.** I. An Assessment of Standard Orifice Forms.– Unique properties of the sharp-edged orifice which have resulted in its extensive use as a flow measuring device, detailed description of the two most widely used orifice forms, common basis is established for presenting coefficient data for the two orifice forms. – T. H. Redding. *Instrument Practice*, v. 15, Aug. 1961, p. 988-995.

Water Layer Speeds **Heavy-Crude Flow.**– How **water as a bottom layer** in a pipeline carrying viscous crude oil can reduce pressure gradients to one-tenth of those encountered in a line carrying such crude alone. – M. E. Charles. *Oil and Gas Journal*, v. 59, no. 35, Aug. 28, 1961, p. 68-72.

• One-Dimensional Adiabatic Flows of **Ultrarelativistic Gas.**– (*In Russian.*) Odnorazmernye adiabaticheskie techeniia ul'trareliativistskogo Gaza. – K. P. Staniukovich. *Akademiia Nauk SSSR, Doklady*, v. 139, no. 3, July 21, 1961, p. 590-593.

Linearized **Supersonic Nonequilibrium Flow** Past an Arbitrary Boundary.– Supersonic small-perturbation flow field past an arbitrary boundary is found, by the Laplace transformation, at the vicinity of the initial outgoing frozen Mach line, the vicinity of the boundary, and far downstream of the initial outgoing frozen Mach line. – James J. Der. *U. S. National Aeronautics and Space Administration, Technical Report, NASA-TR*-R 119, Aug. 1961, 33 pp. (TL521 Un3ra Vis.)

• Transverse Oscillations of a **Liquid Jet.** II.– A thin rectangular liquid jet impinges on the apex of a rigid wedge and, under suitable circumstances, sets itself into any of a number of modes or "stages" of steady-state transverse oscillation; any mode has associated with it a pattern of vortex production. Excerpts from **motion pictures** show sequences of **jet configurations** corresponding to the different modes of oscillation. In a photographic history depicting the building of oscillations in an initially quiescent jet, particular interest is attached to the fact that oscillations appear before vortices have developed. Observations from these photographs and results from an earlier paper are compared with predictions of recent theories of edge tone production. – J. Bruce Brackenridge and Wesley L. Nyborg. *Acoustical Society of America, Journal*, v. 33, Aug. 1961, p. 1078-1084.

• Permeability of **Porous Solids.**– An expression has been derived to describe both saturated and unsaturated **permeability** of porous media in terms of the pore size distribution as obtained from **mercury-injection** data or water-desorption isotherms. – R. J. Millington and J. P. Quirk. *Faraday Society, Transactions*, v. 57, July 1961, p. 1200-1207.

FOOD TECHNOLOGY

Effect of **Active Carbon** on the Storage Stability of **Irradiated Meats.** – Preparation, canning, freezing, irradiation and storage of meats and the results of testing and evaluation of **storagestability** after various periods. – Gerald D. Gernon, Jr., Fred J. Kraus, and Maurice P. Drake. *Food Technology*, v. 15, Aug. 1961, p. 354-356.

• **Amino Acid Requirements** of Children: Minimal Needs of **Lysine** and **Methionine** Based on Nitrogen Balance Method. – Itsiro Nakagawa, Tetsuzo Takahashi, and Takeshi Suzuki. *Journal of Nutrition*, v. 74, no. 4, Aug. 1961, p. 401-407.

• The Influence of **Chain Length** of the Saturated Fatty Acids on Their Effect on Serum **Cholesterol Concentration in** Man.– A diet containing a high proportion of **saturated fatty acids** of 12 and 14 carbon atoms produced a significantly higher serum cholesterol concentration than did a matching diet differing mostly in the proportion of saturated fatty acids. – Francisco Grande, Joseph T. Anderson, and Ancel Keys. *Journal of Nutrition*, v. 74, no. 4, Aug. 1961, p. 420-428.

FUELS AND COMBUSTION

Three Unconventional Sources of **Energy.**– Discussion of **solar** radiation, **wind** power, and **geothermal** energy. – E. W. Golding. *Engineering*, v. 192, Aug. 18, 1961, p. 198-199.

Unfurlable **Solar Collector** Is Developed.– Working model of a lightweight, parabolic collector capable of **unfurling** like a flower in space, then efficiently collecting and concentrating enough solar heat for a thermoelectric or a solar dynamic **power system.** – Barry Miller. *Aviation Week and Space Technology*, v. 75, Aug. 14, 1961, p. 81 + 1 page.

Inhibition of Diffusion Flames by **Methyl Bromide** and Trifluoromethyl Bromide Applied to the Fuel and Oxygen Sides of the Reaction Zone.– It was found that when the **flame inhibitor** was added to the fuel, the volume percentage required for extinguishment was much greater than when added to the O side of the **reaction zone,** with the single exception of CO flames inhibited by trifluoromethyl bromide. – E. C. Creitz. *U. S. National Bureau of Standards, Journal of Research, Section A, Physics and Chemistry*, v. 65A, no. 4, July-Aug. 1961, p. 389-396.

• Pulverized Lignite Fuels Large **Utility Boiler.**– First and largest pulverized lignite reheat boiler in the northern Great Plains area completed a year of successful operation while contributing substantially to the art of burning **North Dakota lignite.** – H. R. Cowles. *Power Engineering*, v. 65, Aug. 1961, p. 39-41.

• **Soot:** Its Structure and Role **in Luminous Flames.** – P. J. Foster and I. A. McGrath. *Sheffield University, Fuel Society, Journal*, v. 12, 1961, p. 60-67.

• **Natural Gas** and the Competitive **Fuel Market.** – Francis J. Quinn. *Journal of Petroleum Technology*, v. 13, Aug. 1961, p. 727-730.

High Velocity Combustion Applied to **Chemical Processing.** II.– Discussion of burner systems, direct fired air and gas heating, fired heat exchangers, submerged combustion, and inert gas generation. – Leonard C. Peskin. *Chemical Engineering Progress*, v. 57, Aug. 1961, p. 82 + 1 page.

• The Combustion of Droplets of **Liquid Fuel.**– **Droplet size** and composition, ambient temperature, composition and pressure, and the relative **velocity** of the droplets and the gas have on the combustion characteristics of single droplets of liquid fuels. – E. G. Masdin. *Sheffield University, Fuel Society, Journal*, v. 12, 1961, p. 17-28.

• An Appraisal of Research on the **Combustion** of **Pulverised Coal.** – J. M. Beer. *Sheffield University, Fuel Society, Journal*, v. 12, 1961, p. 29-41.

Solid Rockets for **Space Vehicles.**– Programs and experimentation have indicated the feasibility of the large, **solid booster,** but problems centering on long burning times, man-rating the motor, reliability, ignition, and vehicle dynamics must be solved before it becomes a reality. – William Cohen. *Astronautics*, v. 6, Aug. 1961, p. 22 + 7 pages. a

• Combustion of **Coal** by Gasification.– Construction and test results of a continuously operating **gas producer,** which was test-built to verify this method, are described and it is shown that this producer can be operated at a **gasification efficiency** (hot gas base) of 94% for a long period by employing an improved injection method of air and steam. – Kensuke Kawashimo and Kozo Katayama. *Bulletin of JSME*, v. 4, no. 14, May 1961, p. 422-430. b

• **Atomization** of Liquid Fuel for Combustion. II.– Atomization in a **liquid fuel** combustion system is considered as a mass transfer operation, and the factors influencing the rate of evaporation of drops and sprays are discussed. The mechanisms of liquid disintegration are detailed and the practical means of achieving clouds of finely divided drops from atomizers are described. – Paul Eisenklam. *Combustion*, v. 33, no. 2, Aug. 1961, p. 27-34. c

Formation of Boron Nitride in **Diborane-Hydrazine Flames.** – The reaction products consist principally of **boron nitride** and hydrogen, according to the reaction $B_2H_6+N_2H_4 \rightarrow 2BN+5H_2$. The reaction is sufficiently exothermic for it to proceed without difficulty. – W. G. Berl and W. E. Wilson. *Nature*, v. 191, July 22, 1961, p. 380. d

• Tables of **Ozone Properties.**– A brief description followed by **tables** of selected data on ozone properties. – A. G. Streng. *Journal of Chemical and Engineering Data*, v. 6, no. 3, July 1961, p. 431-436. e

Underground Gasification of Coal: Operation of Multiple-Path System.– A system was designed and constructed so that air could be injected into the coalbed at a center borehole and the product gases could be exhausted at several boreholes arranged in a circle around the center. – John P. Capp, Robert W. Lowe, and Everett F. House. *U. S. Bureau of Mines Report of Investigations* 5830, 1961, 13 pp. (TN21 Un3r Room 290) f

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• New Advances in the Field of Hydrocarbon **Synthesis Gas Production.**– Fauser-Montecatini plants make use of the autothermal process; they are internationally adopted for the oxidation of different hydrocarbon feeds, both gaseous and liquid. Reports operation data and illustrations of the most modern plants of this kind. (*In Italian.*) Recenti progressi nella produzione del gas di sintesi da idrocarburi. – Augusto Righi. *Chimica e l'Industria*, v. 43, June 1961, p. 631-637. i

• Adjusting a Deethanizer by Means of a **Process Chromatograph.**– Upon obtaining propane from natural gas, it is practical for economical reasons to leave the maximum admissible quantity of ethane in the propane. To accomplish this, a process chromatograph is used to analyze the gas contents of a deethanizer measuring the percentage of **ethane** at regular time intervals. The result of each analysis is stored by a sensing unit and can thus be used as a controlling quantity. (*In German.*) Regelung einer Äthan-Trennsäule mit Hilfe eines Prozess- j k

Chromatographen. – D. J. Fraade. *Regelungstechnik*, v. 9, July 1961, p. 269-273.

GEOLOGY, GEOPHYSICS, MINERALOGY, AND MINING ENGINEERING

Measuring the Sky's Electrical Noise.– On the use of antennas and amplifiers to measure **atmospheric noise.** – D. C. Hogg and H. E. D. Scovil. *Bell Laboratories Record*, v. 39, Aug. 1961, p. 276-279.

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• Wanted--A Better **Source of Beryllium.** – Robert B. Rowe. *Canadian Mining Journal*, v. 82, Aug. 1961, p. 55-57.

• Size and Mass Distribution of **Cosmic Dust.**– Size **distribution** of cosmic dust in space, as computed from the data obtained by impact measurements by artificial satellites. – Taivo Laevastu and Otto Mellis. *Journal of Geophysical Research*, v. 66, no. 8, Aug. 1961, p. 2507-2508.

• Effects of Corpuscular Emissions on the Polar Ionosphere Following **Solar Flares.**– Morphology of two **polar absorption** events, July 24-25 and Sept. 18-22, 1957, representing different types of **ionospheric disturbances,** is presented. – G. E. Hill. *Journal of Geophysical Research*, v. 66, no. 8, Aug. 1961, p. 2329-2335.

• The Hurst Method of **Water Flood Prediction.** I.– A series of articles discussing **Hurst method.** – C. Drew Stahl. *Producers Monthly*, v. 25, no. 8, Aug. 1961, p. 8.

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• Salt Characteristics as They Affect Storage of **Hydrocarbons.** – Results of laboratory tests, field tests, and field observation of **salt characteristics** pertinent to either the **storage** of hydrocarbons or the disposal of industrial wastes. – W. R. Aufricht and K. C. Howard. *Journal of Petroleum Technology*, v. 13, Aug. 1961, p. 733-738.

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Solar Research From **Rockets.** – R. Tousey. *Science*, v. 134, Aug. 18, 1961, p. 441-448.

Prospects for Controlling and Forecasting the **Weather.**– The problems of **long-range forecasting** are now being attacked by **mathematical physics.** They are yielding gradually, and with an economic return sufficient to justify the charting of the atmosphere of the whole earth's surface. – R. C. Sutcliffe. *Discovery*, v. 22, Aug. 1961, p. 350-355.

• Why **Mohole?**– A comprehensive up-to-date run-down on one of the most significant geophysical research projects of our time. – *Undersea Technology*, v. 2, no. 2, May-June 1961, p. 24-28.

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• Analysis of Gravitational and **Geometric Aspects** of Geodetic Utilization of **Satellites.**– A general geometric and statistical treatment of all types of observations is developed, with the purposes of obtaining rigorous evaluations of orbital and observational schemes, and optimum solutions for **geodetic positions,** gravitational harmonic coefficients, and orbital elements. – W. M. Kaula. *Geophysical Journal*, v. 5, no. 2, July 1961, p. 104-133.

• Sound-Speed Measurements Utilizing the **Bathyscaph** TRIESTE.– **Sound-speed measurements** and corresponding oceanographic data were obtained to a depth of 5760 m. Subsequent measurements were made in shallow northern waters by lowering the velocimeters and Nansen bottles from a surface ship. – K. V. Mackenzie *Acoustical Society of America, Journal*, v. 33, Aug. 1961, p. 1113-1119.

The Closest Packing of Spheres (A Unifying Basis for **Crystal Structures**).– Qualitative features of the concept are sorted out and correlated by successively treating single, double, triple, and multiple layered arrays of **closest packed spheres.** The importance of the interstice lattices is emphasized. A translation-permutation algebra is developed for the purpose of quantitatively stating the qualitative features of closest packing. – William G. Gehman. *U. S. Atomic Energy Commission, NAA-SR-6003*, July 30, 1961, 66 pp. (UF767 Un3.1na Contin.)

• The **Uranium Isotopes** in Nature. I. **Actinium-Radium Ratio** of Minerals.– The Ac/Ra ratio was investigated in 35 natural minerals by two methods according to the spectrum of products of the active deposit on the ionization α-spectrometer and according to the count of impulses of An+AcA with the aid of scintillation counters. Considerable deviations of the Ac/Ra ratio (till Ac/Ra=8) are observed in metamorphosed minerals. In some cases it may be shown with certitude that this is caused by the migration removal of Ra. (*In Russian.*) Izotopy urana v prirodnykh usloviiakh. I. Aktinii-radievoe otnoshenie minerалov. – V. V. Cherdyntsev, et al. *Geokhimiia*, 1961, no. 8, p. 650-655.

• The Origin of Ring Currents in the Region of the **van Allen Radiation Belt.**– The measurement of the earth's magnetic field in the region of the outer van Allen radiation belt at a geocentric distance of between 20,000 and 50,000 km shows two distinct field anomalies which are supposed to be caused by **ring currents.** (*In German.*) Über den Ursprung von Rigströmen im Bereich der van Allen-Strahlungsgürtel. – R. Fiebig and H. Voelcker. *Atomkernenergie*, v. 6, July-Aug. 1961, p. 300-309.

Rocket-Motor-Generated **Condensation Trails.**– Atmospheric states that will cause the formation of condensation trails when the exhaust from a rocket motor mixes with and saturates the atmosphere. It was assumed that the rocket-motor **propellants** would be **aircraft fuel and liquid oxygen.** – Edward J. Tschupp. *American Meteorological Society, Bulletin*, v. 42, Aug. 1961, p. 543-547.

U. S. Seeks **Oceanography Instruments.**– Industry told it must turn out inexpensive, rugged and accurate devices to support expanding effort; Navy to buy $46 million worth. – William Beller. *Missiles and Rockets*, v. 9, no. 9, Aug. 28, 1961, p. 22-23.

• **Silicon** in the Metal Phase of **Enstatite Chondrites** and Some Geochemical Implications.– Evidence relating to the possible occurrence of Si in the earth's core is reviewed, and the significance of the new meteoritic data in relation to this hypothesis is discussed in some detail. – A. E. Ringwood. *Geochimica et Cosmochimica Acta*, v. 25, no. 1, Aug. 1961, p. 1-13.

• Beryllium-Bearing Tuff in the Thomas Range, Juab County, Utah.– Recently discovered **Be deposits** in the Thomas Range, **Utah,** are along the periphery of the fluorspar district at Spor Mountain; district promises to be an important source of Be. – Mortimer H. Staatz and Wallace R. Griffitts. *Economic Geology*, v. 56, no. 5, Aug. 1961, p. 941-950.

A Hole in the Bottom of the Sea.– Story of the **Mohole Project** objective being, to develop the equipment needed to drill five to six miles into the earth's crust. Test explains the many fields - geology, oceanography, engineering, modern drilling technology, and others in relation to oceanic drilling. Also shows how the geological and geophysical characteristics of the earth have developed over the ages; and explains volcanoes, earth-

quakes, seismology, geology, oceanography, and many other things. – Willard Bascom. 352 pp. 1961. Doubleday & Company, New York. (QE509 B29h)

Physics of the **Aurora and Airglow.**– Subjects of interest are radiation in spectral lines, scattering of radiation in finite atmospheres, auroral spectroscopy and photometry, radio-aurora, physical processes in the auroral atmosphere, airglow spectrum, analysis of twilight observations for emission heights, spectral photometry, excitation of the nightglow, and other subjects.– Joseph W. Chamberlain. v. II. 704 pp. 1961. Academic Press, New York. (QC971 C35p)

Comparative Optical and Interferometric Studies on **Synthetic Diamonds.** – S. Tolansky. *Royal Society, Proceedings*, v. 263, ser. A, Aug. 22, 1961, p. 31-38 + 3 plates.

Time Variations of **Directional Cosmic Ray Intensity** at Low Latitudes. I. Comparison of Daily Variation of the Intensity of Cosmic Rays Incident From East and West. II. Time Variations of East-West Asymmetry. III. Interpretation of Solar Daily Variation and Changes of East-West Asymmetry. – U. R. Rao and V. Sarabhai. *Royal Society, Proceedings*, v. 263, ser. A, Aug. 22, 1961, p. 101-135.

Contributions to the **Oil and Gas** Industry in **Ohio.**– A collection of papers covering: gas recycling and slim hole completions in the Clinton sand, are Clinton sand floods economically feasible, gas repressuring project - Clinton formation, big frac or little frac, and cost cutting with **cable tool drilling.** – *Ohio, Geological Survey, Information Circular No.* 29, 1961, individually paged. (QE151 Oh3.3i Vis.)

Introducing **Oceanography.**– Fascinating articles depicting **instrumentation** at work in the deep. ISA Marine Sciences Division outlines its structures and objectives. – James M. Snodgrass. *ISA Journal*, v. 8, Aug. 1961, p. 74-79.

GRAPHIC ARTS

° **Explosive Flashlight.**– Uses a new sheet explosive which has been developed to provide the needed illumination for a **camera** that photographs up to 4,300,000 frames per second. – Jack Gershon and Richard H. Stresau. *Frontier*, v. 23, no. 1, Summer 1961, p. 18-20.

° **Proximity Switching** Applied to the **Printing Industry.**– Design and application of a sensitive proximity switch as an aid to positioning, counting, or location of printed matter. – W. Kiryluk. *Automation Progress*, v. 6, Aug. 1961, p. 270-272.

Printing Inks.– The use of gravure, flexographic, offset, flourescent, copper-plate, metallic, and magnetic inks. – A. H. Soane. *Paint Manufacture*, v. 31, Aug. 1961, p. 290-292.

Flexographic Inks.– Advantages and individual formulation problems of flexographic inks. – E. A. Apps. *Paint Manufacture*, v. 31, Aug. 1961, p. 269-274.

° The **LTF Star Target** for Ink Spread and Resolution Measurements.– When printed on a press sheet it gives the pressman a quick and effective measurement of any **ink spread,** slur, and doubling in his presswork. The target is also used for **resolution measurements** in camera work and platemaking. – George W. Jorgensen. *Inland and American Printer and Lithographer*, v. 147, no. 5, Aug. 1961, p. 42-43.

Applying the **Kerr Cell** to **Nanosecond Photography.** – S. M. Hauser and H. Quan. *Electronics*, v. 34, no. 33, Aug. 18, 1961, p. 56-59.

° **Magnetic Ink** Imprinting--Why It's Needed, What It Does.– Describes a universalized system with the introduction of a Common Machine Language using Magnetic Ink Character Recognition as its basis. With this system, both electronic machines and the human eye can read the same number printed in magnetic ink. – William Ward Davidson, Jr. *ODR Reproductions Review*, v. 11, July 1961, p. 18 + 2 pages.

° How **Paper** Affects Formulation of **Printing Ink.** – Joseph Krause. *American Ink Maker*, v. 39, Aug. 1961, p. 28-29.

a Giant's-Eye View.– A technique that enables **air travelers** to take **stereo pictures** that show amazing depth, even with single-lens cameras. The trick is to shoot twice in rapid succession, letting the plane's movement provide separation of viewpoints. – Paul Wing, Jr. *PSA Journal*, v. 27, July 1961, p. 6-9.

° Pleasing Colour.– A short-run **three-color reproduction system** is described. – *British Printer*, v. 74, July 1961, p. 97-100.

b ° **Lithography's** First Century: The Decades of Development.– Historical sidelights on progress from senefelder to offset. – James Mosley. *British Printer*, v. 74, July 1961, p. 101-108.

° Broadening Application of **Presensitised Plates.**– Reviews the characteristics of Sensalith plates, first produced for small-**offset** machines but now available in standard sizes. – Stanley Potter. – *British Printer*, v. 74, July 1961, p. 146 + 1 page.

c ° Recent Contributions of **Inkmaking** Technology to **Offset-Litho Progress.**– An examination of some of the factors which have encouraged the wider adoption of the process. – Peter Lister. *British Printer*, v. 74, July 1961, p. 154 + 2 pages.

° **Dycril Plates** Aid **Letterpress** Process. II.– Photopolymer plate may be made in 20 min. on relatively inexpensive equipment. Survey of some controversial points reveals experiences of printers, engravers, and typesetters. – James R. Whitney. *Inland and American Printer and Lithographer*, v. 147, no. 4, July 1961, p. 60-61.

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° Screen Rulings for Blocks and **Paper Printability.**– Describes technique which enables printers to choose the most suitable **screen ruling** for blocks to be printed on any given batch of paper, without having to carry out conventional printing trials. – Sylvia D. Winn. *Patra Journal*, (New Series), v. 1, no. 1, Jan. 1960, p. 21-22.

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° **Magnetic Printing.** – *American Ink Maker*, v. 39, July 1961, p. 31 + 2 pages.

f ° The Technique of **Marbling.**– New techniques for decorating endpapers and books enlarge the market for marbled papers. Novel tricks of the trade are described by an expert. – Samuel Webb. *Book Production*, v. 74, no. 1, July 1961, p. 34-35.

° Xerography for Close-Access Recording of Continuous-Tone Line-Scan **Cathode-Ray Tube Presentations.**– An experimental device has been developed to demonstrate the use of xerographic techniques for displaying and recording **continuous-tone information** with very short delay. Incoming continuous-tone signals generate a line scan on a high-intensity high-resolution cathode-ray tube. Details concerning the cathode-ray tube input, the optical system, the **xerographic processor,** and the test results are included. – John T. Bickmore and Allen H. Ett. *Photographic Science and Engineering*, v. 5, no. 3, May-June 1961, p. 136-141.

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h ° The Printing of Underexposed Photographs by Means of **"Optical Contrasters".** – Michel Cloupeau. *Photographic Science and Engineering*, v. 5, no. 3, May-June 1961, p. 175-180.

High-Speed Photography in the Study of **Two-Phase Flow.** – Measurements of ripple or wave velocities in annular flow and bubble velocities in bubble and slug flows. Qualitatively, the **motion pictures** permit better understanding of the interactions between the two phases. – R. A. S. Brown and G. W. Govier. *Canadian Journal of Chemical Engineering*, v. 39, no. 4, Aug. 1961, p. 159-164.

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° Location of the Plane of Best Average Definition With Low Contrast Resolution Patterns.– **Plane of best average definition** is located for each of several **airplane-camera lenses** using two types of low-contrast test pattern and two emulsions. – Francis E. Washer and William P. Tayman. *U. S. National Bureau of Standards, Journal of Research, Section C, Engineering and Instrumentation*, v. 65C, no. 3, July-Sept. 1961, p. 195-202.

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High-Intensity, Fractional-**Microsecond Light Sources.**– Sources provide a small-area electric spark with a peak brightness of approximately 50 million candles/cm², and a duration of less than 0.5 μsec. – Philip Nolan. *Society of Motion Picture and Television Engineers, Journal*, v. 70, Aug. 1961, p. 632-633.

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Developments in **Magnetic Striping 8mm Sound Film.**— Edward Schmidt. *Society of Motion Picture and Television Engineers, Journal*, v. 70, Aug. 1961, p. 607-610.

A Self-Contained Recorder for **Motion-Picture Sound.**— Self-contained, battery-operated and transistorized **tape recorder** is described which provides synchronization with both spring-driven and motor-driven cameras. — William V. Stancil. *Society of Motion Picture and Television Engineers, Journal*, v. 70, Aug. 1961, p. 597-599.

Compact **Rear-Screen Projector** for 8mm Films With **Magnetic Sound Stripe.**— Properties of **8mm film,** equipment advantages, results of life test runs, and applications of 8mm equipment are described. — R. G. Hennessey. *Society of Motion Picture and Television Engineers, Journal*, v. 70, Aug. 1961, p. 590-592.

The Challenge of **8mm Sound Film.**— Examines major technical and economic obstacles to be overcome before the potential can be fully realized. — John Flory. *Society of Motion Picture and Television Engineers, Journal*, v. 70, Aug. 1961, p. 581-585.

Our new format should help you scan the page quickly. Boldface clue words identify subject matter. Titles appear unchanged at the beginning of each abstract.

• Further Studies of the Influence of **Acoustic Microstreaming** on the **Photographic Development** Process. — Francis J. Jackson. *Acoustical Society of America, Journal*, v. 33, Aug. 1961, p. 1144-1145.

• The Adsorption of **Developing Agents** to a Dropping-Mercury Electrode.— The **adsorption** of developing agents has been studied on a **dropping-mercury electrode**. Metol and catechol are desorbed from a negatively-charged surface less readily than hydroquinone because they are able to adopt an "end on" or "edge on" position and thereby separate the negatively-charged group and surface. — P. J. Hillson. *Journal of Photographic Science*, v. 9, no. 4, July-Aug. 1961, p. 234-242.

• **Surface-Image Bleaching** of Silver-Iodide Emulsions.— Previous results which showed that the surface images of **silver-iodide emulsions** were not completely destroyed in conventional latent-image bleaches have been confirmed. It is shown that the print-out image is more readily destroyed, particularly by the **silver-dichromate** bleach, than the latent image. — E. A. Sutherns. *Journal of Photographic Science*, v. 9, no. 4, July-Aug. 1961, p. 230-233.

HUMAN FACTORS

• Some Cognitive Aspects of **Motivation.**— Considers the possibility that what we call motives are really a particular kind of **perceptual or cognitive event.** — W. C. H. Prentice. *American Psychologist*, v. 16, Aug. 1961, p. 503-511.

Limits of **Human Vision.**— Use of **fundus reflectometry** provides a means for studying the properties of visual pigments in the living eye. — R. A. Weale. *Nature*, v. 191, July 29, 1961, p. 471-473.

• Human-Factors Engineering. Design Standards.— The step-by-step procedures in developing and applying **human-factors** "guidelines" and "checklists" used in the design of equipment for the Polaris (fleet ballistic missile) **submarines.** The basic approach is also applicable to human-factors engineering problems in many other systems. Search and evaluation of system components (such as **controls and displays**) are essential steps in the development of these standards and specifications. — Martin A. Tolcott, Armand N. Chambers, and Paul Preusser. *Electro-Technology*, v. 68, no. 2, Aug. 1961, p. 103-109.

• Power, People, and **Performance Reviews.**— Explores the range of supervisory practice from absolute dictatorship to complete permissiveness, and its significance in performance appraisal and motivation. — Robert R. Blake and Jane Srygley Mouton. *Advanced Management*, v. 26, July-Aug. 1961, p. 13-17.

The Development of **Problem-Solving Ability.**— Experiments already conducted on **animals and children** suggest that there is a common pattern in the above. Much research remains to be done on the relationship between the development of **linguistic ability** and problem-solving ability. — Ian M. L. Hunter. *Discovery*, v. 22, Aug. 1961, p. 344-349.

Luminous Bar Indicators Cut Down Readout Errors.— System provides a great deal of operating information in a logical sequence and so reduces not only **readout errors** but also system trouble-shooting time. In a special application, a color display varies continuously from a deep blue at minimum temperature to a high red at maximum. — Albert L. deGraffenried. *Space/Aeronautics*, v. 36, no. 2, Aug. 1961, p. 70-73.

• Normalized Representation of Noise-Band Masking and Its Application to the Prediction of **Speech Intelligibility.**— Measurements are made of the masking of pure tones by various bands of noise. Curious masking spreads beyond upper frequency limits of noise are observed and these are expressed uniquely by means of the relative masking and the incremental bandwidth. Then the normalized representation of **noise-band masking** in some restricted ranges is achieved and applied for the prediction of speech intelligibility. Predicted articulation scores agree fairly well with measured ones. — Shuzo Saito and Shingo Watanabe. *Acoustical Society of America, Journal*, v. 33, Aug. 1961, p. 1013-1021.

• Studies on the **Aural Reflex.** I. Contralateral Remote Masking as an Indicator of Reflex Activity.— The phenomenon of **"contralateral remote masking"** is described: the elevation of threshold sensitivity to a low-frequency tone in one ear produced by a high-frequency band of noise in the other. Evidence is presented indicating that this effect is mainly attenuation induced by reflex activation of the **stapedius muscle,** although probably some central masking is also involved. — W. Dixon Ward. *Acoustical Society of America, Journal*, v. 33, Aug. 1961, p. 1034-1045.

• Operating Characteristics, **Signal Detectability,** and the Method of **Free Response.**— Against a background of noise, a weak signal is presented several times in a long (2-min) observation interval. The temporal intervals between the presentations of the tones are randomly distributed; consequently, the listener does not know when a tone will occur, and he does not know how many tones will be presented. From one series of observation intervals to the next, the listener is instructed to adopt various criteria and to press the single response-key each time he "hears a tone." The problem consists in the determination of a procedure that allows the total number of yes responses to be partitioned meaningfully between "hits" and "false alarms." A model is developed in which the measurable quantity, rate of response, is related to the "hit rate" and to the "false-alarm rate." Although the criterion adopted by the listener cannot be directly evaluated, the use of a wide range of criteria makes it possible to estimate the detectability d of the signal. Two experiments are described, and the results support the model. — James P. Egan, Gordon Z. Greenberg and Arthur I. Schulman. *Acoustical Society of America, Journal*, v. 33, Aug. 1961, p. 993-1007.

• Sequential Effects in the **Signal-Detection** Situation.— Examines some sequential effects found in the **behavior of observers** in the signal-detection situation. The Tanner-Swets-Green model treats the subject as a stable decision maker operating on information from a noisy but unbiased transducer. — S. D. Speeth and M. V. Mathews. *Acoustical Society of America, Journal*, v. 33, Aug. 1961, p. 1046-1054.

Systems and Theories of **Psychology.**— Discusses various aspects of systemic psychology, including sensation, perception, learning, thinking, motivation, feeling, emotion, and personality. — J. P. Chaplin and T. S. Krawiec. 473 pp. 1960. Holt, Rinehart and Winston, New York. (BF105 C36s Eng. Phys. Lib.)

INFORMATION RESEARCH

The Inadequacy of Varying the **Depth of Indexing** and Other **"Document Collection"** Approaches to Information Retrieval for Researches.— Author disagrees with and comments on several basic approaches to **information retrieval** that are widely used and accepted. — Ron Manly. *American Documentation*, v. 12, no. 3, July 1961, p. 204-205.

Some Suggested **Mechanized Indexing** Investigations Which Require No Machines. — John O'Connor. *American Documentation*, v. 12, no. 3, July 1961, p. 198-203.

Automatic Syntax Analysis in **Machine Indexing** and Abstracting.— Automatic syntax analysis is used here to describe a method of mechanizing the recognition of the phase structure of English and some of the relations between clauses in the sentence. Its purpose is to indicate the syntactic function of the elements of a sentence. This paper describes a **syntax analysis** program and some of the techniques which have been studied for its utilization to provide the initial formalization for **natural language processing**.— W. D. Climenson, N. H. Hardwick, and S. N. Jacobson. *American Documentation*, v. 12, no. 3, July 1961, p. 178-183.

Classified **Patent Search Files**, A Proposed Base for Technical Information Centers.— States that a **pilot center** should be created to test the feasibility and cost of decentralization of Patent Office search files, at present available to the public only in Washington. These files would serve as a basis for a number of search centers at locations in other parts of the country. — Simon M. Newman. *American Documentation*, v. 12, no. 3, July 1961, p. 206-209.

"Information Storage and Retrieval" and the Problems of Libraries. — Verner W. Clapp. *American Documentation*, v. 12, no. 3, July 1961, p. 224-226.

Now--**Automated Information Retrieval.**— No one can be sure how far mechanization will go in large-scale information retrieval. Besides the regular search and retrieval systems, it will depend partly on how rapidly "accessory" equipment comes along: machines for **language translation**, report reading, **abstracting**, and **indexing**. — *Management Review*, v. 50, Aug. 1961, p. 33-36.

• Enlightenment by Films.— Reviews of use of **motion picture** films in **education** and research. — D. M. Freeland. *Chemistry & Industry*, 1961, no. 32, Aug. 12, p. 1264-1266.

• What's Wrong With **Machine Instruction Manuals?**— Says current machine manuals are too vague and general for operator and maintenance personnel. — Irving I. Rubin. *Plastics Technology*, v. 7, Aug. 1961, p. 33 + 3 pages.

Engineering and Research Reports.— How to develop **technical reports** to insure adequate **communication** in engineering and research operations. — Robert G. Murdick. *Machine Design*, v. 33, Aug. 31, 1961, p. 70-75.

Inform for Profit Growth.— Points out need for **national information center** to collect and disseminate published documents. Example of **computer magnetic tape** unit to store and search documents. — Allen Kent. *Steel*, v. 149, Aug. 28, 1961, p. 49-52.

• Facts About **Fact-Finding.**— A leading-executive tells how to find obscure facts on engineering problems and how to keep track of them later. — Robert S. Casey. *American Engineer*, v. 31, Sept. 1961, p. 23 + 5 pages.

INSTRUMENTATION

The Pumping of Nitrogen by a Bayard-Alpert Ionization Gauge in an Ultra-High-Vacuum System.— The **pumping speed** for N of a **Bayard-Alpert ionization gauge** was measured in a system with pressures between 10^{-9} and 10^{-7} mm Hg. — J. P. Hobson. *Vacuum*, v. 11, no. 1, Feb. 1961, p. 16-25.

a • Application of Vacuum Process Evaluation to the Study of **Outgassing.**— Technique and its application in determining the optimum combination of such parameters as temperature, time, materials, restrictions, and pumps on such processes as hermetic volume exhaust and cellulose dehydration are described. Vacuum process evaluation techniques are used to study such phenomena as the outgassing characteristics of insulating materials and vacuum gages, the flow of gases through orifices and short tubes, and the gettering action of materials. The method has been programmed for **digital computer solution** and is a rapid and inexpensive way to analyze some vacuum engineering problems. — D. J. Santeler. *Vacuum*, v. 11, no. 1, Feb. 1961, p. 1-9.

b • The Vacuum Use of **Molecular Sieves** and Other Desiccants.— Comparison of the adsorption capacity of two column lengths of sieve under dynamic conditions is made, and the pressure differentials across the columns are investigated. The increase in the **adsorption efficiency** when the system is backed by an air ballast rotary pump is shown. Data are also given for **moisture breakthrough, heat of adsorption,** and regeneration times. — Evelyn M. Robson. *Vacuum*, v. 11, no. 1, Feb. 1961, p. 10-15.

c • Simple Apparatus for the **Generation** of Pressures Above **100,000 Atmospheres** simultaneously With Temperatures Above **3000°C.** — William B. Daniels and M. T. Jones. *Review of Scientific Instruments*, v. 32, Aug. 1961, p. 885-888.

d • A Radio-Frequency Resistance **Thermometer.**— Fast response and sensitive resistance thermometer is studied which utilizes the "skin-effect" and "resonance", on condition that a radio-frequency is used instead of d.c. as a power source. Will be useful for measuring the transient temperature change, for instance, a hot gas in the cylinders of **internal combustion engines** and other similar machines. — Fujio Nagao, Shunichi Ohigashi, and Ichiro Higashino. *Bulletin of JSME*, v. 4, no. 14, May 1961, p. 340-346.

e • Automatic Method of **Magnetic Field Calibration** Using Proton Resonance.— A circuit which enables the automatic calibration of a magnetic field to be carried out. A marginal oscillator, frequency controlled by one of 11 quartz crystals mounted in a motorized turret tuner, detects **nuclear magnetic resonance** signals. These signals activate a pen recorder and also trigger a control circuit which advances the turret tuner to the next channel. — A. Horsfield, J. R. Morton, and D. G. Moss. *Journal of Scientific Instruments*, v. 38, Aug. 1961, p. 322-324.

f • Measurement of **Magnetic Field Contours.**— A Simple apparatus is described which can be used to plot the field contours of a laboratory magnet, even when the instability of the field in time is comparable with the variations in space. It consists of two super-regenerative oscillators which produce signals at the nuclear magnetic resonance frequencies of the proton samples in their tank coils. — R. Freeman. *Journal of Scientific Instruments*, v. 38, Aug. 1961, p. 318-321.

g • **Ultra-Violet Absorption** Optical System With **Photoelectric Recording** for a Phywé Ultracentrifuge.— Intensity of a parallel beam of ultraviolet light transmitted by the solution in an **ultracentrifuge** cell is measured by scanning the enlarged cell image with a photomultiplier. The electronic circuit permits the measurement of both transmission and optical density. — J. B. T. Aten and A. Schouten. *Journal of Scientific Instruments*, v. 38, Aug. 1961, p. 325-327.

h • Improved Attachment for **High Temperature Single-Crystal X-Ray Work.**— Permits single-crystal or powder photographs to be taken using Cu radiation up to 900 C. The alignment of the heating element can be checked and altered while the attachment is in use, and the apparatus does not have to be cooled before each film is developed. — A. Barclay and J. D. Donaldson. *Journal of Scientific Instruments*, v. 38, July 1961, p. 286-287.

i • The Linear Diffractometer.— A fully automatic **single-crystal X-ray diffractometer** is described, which uses a mechanical analogue of the reciprocal lattice for setting crystal and counter. — U. W. Arndt and D. C. Phillips. *Acta Crystallographica*, v. 14, pt. 8, Aug. 10, 1961, p. 807-818.

j • A Survey of **Moisture Measuring Instruments** and Devices.— Attempt to survey briefly the field of moisture measuring devices, describing in detail some of the methods more widely used in

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industry. – D. J. Fraade. *Process Control and Automation*, v. 8, Aug. 1961, p. 332-338.

The Universal Precision **Dilatometer.**– Describes dilatometer which records thermal expansion automatically. – G. L. Cutler. *Instruments and Control Systems*, v. 34, Aug. 1961, p. 1471-1473.

A New Kind of **Tachometer.**–The **simple,** speed-indicating device described possesses **low inertia,** low friction, no residual output at zero speed, and a d-c output voltage precisely proportional to speed. – W. H. Middendorf and F. C. Weimer. *Electrical Engineering*, v. 80, Aug. 1961, p. 590-594.

Development of **High Temperature Sensors.**– Investigation of many high temperature metals and alloys resulted in the selection of a Mo or Mo-0.5 Ti element and a Cb or Cb-1 Zr element for high temperature **reactor thermocouple** use. – *U. S. Atomic Energy Commission, PWAC*-339, June 30, 1961, 90 pp. (UF767 Un3.1pw Contin.)

Introduction Into the **Piezoelectric Testing** Technique.– Discusses the problems involved in piezoelectric testing and a concise interpretation of the underlying physical principles. A description of more recent techniques, especially in the field of **piezoelectric ceramics,** together with a review of the existing research and development literature on the subject, are offered in this work. – Werner Gohlke. v. VIII, 2nd Ed. 278 pp. 1959. Akademische Verlagsgesellschaft Geest & Portig K.-G., Leipzig, Germany. (TK381 G55e2)

LUBRICATION AND FRICTION

* Fundamental Research on **Gear Lubrication.**– Experiments with **roller testing** apparatus with which the frictional moment and the electrical resistance between the rollers were measured under various driving conditions of contact load, rolling speed, specific sliding, oil viscosity, relative radius of curvature and roughness of contact surface. – Tokio Sasaki, Kenjiro Okamura, and Ryozo Isogai. *Bulletin of JSME*, v. 4, no. 14, May 1961, p. 382-394.

* **Radiation-Resistant Greases**–A Study of Thickeners and Antirads.– Suitability of various **non-soap thickeners** in the compounding of greases stable to ionizing radiation is discussed on the basis of static irradiation data. Thickeners assessed include modified clays and silicas, a dye pigment, and aryl urea, and magnesium *n*-octadecyl terephthalamate. – W. Crawford and D. B. Cox. *Institute of Petroleum, Journal*, v. 47, Aug. 1961, p. 267-283.

* Electron Microscope Examination of Thin Sections of **Lubricating Grease Thickeners.** – J. W. Wilson, Jr. *NLGI Spokesman*, v. 25, no. 6, Sept. 1961, p. 165-175.

Development and Application of the **Oxidometer.**– A portable, transistorized field instrument (called an oxidometer) was developed to ascertain the relative **quality of lubricating oils.** Its operation is based on the principle that the dielectric constant of a hydrocarbon material increases with the degree of deterioration. This instrument was designed to test oils with initial dielectric constants from 2.18 to 2.24. This range includes a large number of lubricating oils in general plant use. Modifications are under consideration to extend the range to cover a wider selection of oils. – J. B. Mankin, Jr. *U. S. Atomic Energy Commission, Y*-1358, July 14, 1961, 21 pp. (UF767 Un3.1y Contin.)

* Flow Properties of Modern **Lubricating Oils.**– Illustrates some of the types of behavior that can occur in these multicomponent systems with particular emphasis on non-Newtonian **flow properties.** – Roger S. Porter and Julian F. Johnson. *American Society of Naval Engineers, Journal*, v. 73, no. 3, Aug. 1961, p. 511-515.

MECHANICAL ENGINEERING

* **Self-Excited Rolling** Motion of a Vehicle Suspended by **Air Springs.**– Analysis and discussion are made to see under what conditions this motion arises and how to design and **control** system of air springs so as to be able to prevent such motion. – Yoshikazu Sawaragi, Hidekatsu Tokumaru, and Kunio Habuka. *Bulletin of JSME*, v. 4, no. 14, May 1961, p. 267-273.

* Some **Design Characteristics** of the Internal Gear Pair.– Advantages which are offered by **internal gears,** from the standpoints of load-carrying capacity and compactness; calculations which are needed to determine whether any given pair of internal involute gears will fulfil! this requirement. A table is included giving pressure angles at tips of teeth for external and internal gears of from 6 to 169 teeth. – A. Fisher. *Machinery (London)*, v. 99, Aug. 2, 1961, p. 270-275.

* The Motion of a **Gyroscope** in a **Cardan Suspension** When There Is a Moment With Respect to the Proper **Rotation Axis.** – (*In Russian.*) O dvizhenii giroskopa v kardanovom podvese pri nalichii momenta vokrug osi sobstvennogo vrasheheniia. – S. A. Kharlamov. *Akademiia Nauk SSSR, Doklady*, v. 139, no. 2, 1961, p. 327-330.

* On Dynamics of the **Damping Gyroscope.**– The properties of the damping gyroscope are investigated as influenced by technological errors. Non-zero signals on an immovable foundation are possible and there exist **translational rotations** about the input axis to which the gyroscope does not respond. (*In Russian.*) K dinamike dempfiryiushchego giroskopa. – Liu Ian-Chzhu. *Moscow, Universitet, Vestnik, Seriia 1, Matematika, Mekhanika*, v. 16, no. 4, July-Aug. 1961, p. 48-57.

How Should You Evaluate **High-Strength Materials?**– Discusses the challenge to the engineer to find stronger and lighter structures. There are subtle differences in high-strength metals which the usual evaluation tests will not disclose. These materials can be rated on the basis of their load-carrying ability (net section strength) in the presence of the **stress raiser** that seems most appropriate. – G. K. Manning. *Metal Progress*, v. 80, no. 3, Sept. 1961, p. 65-67.

How to Design **Rocking Mechanisms.**– Graphical method for designing "waltzing pairs" that roll without sliding. A family of logarithmic spirals gives optimum **transmission angles.** – Kurt Hain. *Product Engineering*, v. 32, no. 37, Sept. 18, 1961, p. 65-70.

METALLURGY

Computer Control for the **Steel Industry.** – E. H. Browning and J. H. Courcoulas. *Westinghouse Engineer*, v. 21, no. 5, Sept. 1961, p. 156-160.

The **Rare Earths.**– Occurrence and extraction of rare earths; preparation of rare-earth metals; properties and applications of rare-earth metals, alloys, and compounds. – F. H. Spedding and A. H. Daane, editors. 641 pp. 1961. John Wiley & Sons, New York. (QD172.R2 Sp31r)

Development of **Niobium-Uranium Alloys** for **Elevated-Temperature Fuel** Applications.– Describes fabrication characteristics, physical and mechanical properties, and corrosion behavior in NaK, Na, and water of niobium-uranium binary alloys containing up to 60 w/o U. – John A. DeMastry, Donald P. Moak, Seymour G. Epstein, Arthur A. Bauer, and Ronald F. Dickerson. *U. S. Atomic Energy Commission, BMI*-1536, Aug. 9, 1961, 64 pp. (UF767 U3b Contin.)

A New **High-Strength Aluminum Alloy.**– Initially introduced as an aircraft forging alloy for highly stressed parts operating at 500 to 600 F, alloy 2219 has demonstrated other outstanding characteristics--good weldability, high strength, and resistance of stress-corrosion cracking--that make it suitable for applications in transportation, missiles, and the chemical process industries. – J. A. Nock, Jr., Marshall Holt, and D. O. Sprowls. *Metal Progress*, v. 80, no. 3, Sept. 1961, p. 87-91.

* The Production of **Non-Ferrous Metal Slab and Bar** by Continuous-Casting and Rolling Methods.– Reviews those processes in the nonferrous industry where **continuous casting** is followed by immediate **continuous rolling** to make use of the residual heat in the cast metal or the cast metal, having appreciable residual heat, is cut into suitable lengths that are reheated in a

continuous sequence, and then rolled to the required form in small mills. – D. M. Lewis. *Metallurgical Reviews*, v. 6, no. 22, 1961, p. 143-192 + 12 plates.

Survey of the Technical and Scientific Uses of **Computers** in the **Iron and Steel Industry.** – D. G. Owen and R. J. Taylor. *Iron and Steel Institute, Journal*, v. 198, pt. 4, Aug. 1961, p. 352-358.

° Applications and **Uses of Titanium** and Its Alloys.– A review with 223 references. – Robert L. Preece and K. W. J. Bowen. *Metallurgical Reviews*, v. 6, no. 22, 1961, p. 241-278.

Columbium Metallurgy.– Proceedings of a Symposium sponsored by the Hudson-Mohawk Section, in cooperation with the Metallurgical Society, American Institute of Mining, Metallurgical, and Petroleum Engineers, Bolton Landing, New York, June 9-10, 1960. Papers cover general areas of fabrication, mechanical properties, general metallurgy, and oxidation and corrosion. – D. L. Douglass and F. W. Kunz, editors. v. X. 746 pp. 1961. Interscience Publishers, New York. (TN799.N7 Sy68c)

Impurity Effects in Commercially Pure **Beryllium.**–A study to determine the role of impurities in Be. It has been found, in agreement with the early work of Mash, that the properties of Be can be altered by **aging treatment.** The rate at which aging proceeds has been determined by **resistivity measurements.** These, in turn, have been related to changes in mechanical properties observed after various aging treatments. X-ray measurements have related the aging process to the growth of one or more types of **precipitate.** – S. H. Gelles and A. K. Wolff. *U. S. Atomic Energy Commission, NMI-1238*, Feb. 10, 1961, 74 pp. (UF767 Un3.1nm Contin.)

° Preparation and Properties of **Yttrium Monocarbide.**– Investigating the conditions required in the **preparation** of Y monocarbide by reducing Y oxide by C in vacuum revealed that Y carbide is formed when charges of stoichiometrical composition are heated at 1900 C. Some of the **physical properties** determined were: microhardness 120 kg/mm², melting temperature 1950±20 C, specific resistance $4 \cdot 10^4$ $\mu\Omega$, thermoelectromotive force - 34.8 μV/degree. (*In Russian.*) Prigotovlenie i svoistva monokarbida ittriia. – G. V. Samsonov, G. N. Makarenko, and T. Ia. Kosolapova. *Zhurnal Prikladnoĭ Khimii*, v. 34, no. 7, July 1961, p. 1444-1448.

The **Handbook** of Alloys of the **Nonferrous Metals.**– Describes phase diagrams, alloy composition, properties, fields of application. A substantially enlarged and improved edition. This manual for the designer and founder surveys the alloy most in use in Germany and abroad from the point of view of composition and application in the metallurgical industry. Phase diagrams with explanations, as well as technical, physical and structural properties of alloys and their behavior during alloying, melting, recrystallization, hardening and tempering, and the effects of mixtures are given. Over 1000 materials are studied, with special consideration for the German alloy patents. (*In German.*) Legierungs Handbuch der Nichteisenmetalle. – Ernst Brunhuber. 2nd Ed. 319 pp. 1960. Fachverlag Schiele and Schön GMBH, Berlin, Germany. (TN758 B83L2)

METALS—CORROSION

° The Influence of Iodide Ions and Carbon Monoxide on the **Anodic Dissolution** of Active **Iron.**– The kinetics of the dissolution of Fe in H_2SO_4 was investigated by polarization measurements in the presence of iodide ions or CO as an inhibitor. The measurements included an oscillographic study of transient phenomena as well as steady states. The adsorption of iodide ions on Fe was measured as a function of iodide concentration and anodic current density. The effects of **iodide ions** and CO depend on the amount of inhibitor adsorbed on the Fe surface. A possible mechanism for the dissolution of Fe in the presence of iodide ions and **carbon monoxide** has been developed in analogy to the mechanism proposed earlier for the behavior in the solutions not containing these inhibitors. – K. E. Heusler and G. H. Cartledge. *Electrochemical Society, Journal*, v. 108, Aug. 1961, p. 732-740.

° Mechanism of the Origin and Development of **Pitting Corrosion** on **Stainless Steel.**– (*In Russian.*) K mekhanizmu vozniknoveniia i pazvitiia pittingovoi korrosii na nerzhaveiushchikh staliakh. – I. L. Rozenfel'd and I. S. Danilov. *Akademiia Nauk SSSR, Doklady*, v. 139, no. 2, 1961, p. 414-417.

The **Transition** From Internal to External Oxidation and the Formation of **Interruption Bands** in **Silver-Indium Alloys.** – R. A. Rapp. *Acta Metallurgica*, v. 9, Aug. 1961, p. 730-741.

An Experimental Survey of Rust Preventives in Water. I. Methods of Testing. II. The Screening of **Organic Inhibitors.** III. Some General Results.– A novel hypothesis to account for corrosion inhibition by anions is presented. – P. Hersch, J. B. Hare, A. Robertson, and Sheila M. Sutherland. *Journal of Applied Chemistry*, v. 11, July 1961, p. 246-271.

° **Stress-Corrosion Cracking** of the AZ31B **Magnesium Alloy.**– Both the incubation period prior to stress-corrosion cracking and its initiation were studied using electrochemical solution potential-time and extension-time oscillographic curves. It is postulated that the crystals most favorably oriented for slip were deformed, on initial stressing of the specimen, to such an extent that they were resistant to further extension, and the protective films on their surfaces, destroyed in the early deformation, were repaired. Subsequent extension occurred as the result of stresses concentrated in relatively more resistant crystals with strain rates as high as 1%/sec at limited sites, rupturing the **protective surface film.** This exposed metal was anodic to very larger areas on which the film had been repaired, and cracks developed by electrochemical processes. – Hugh L. Logan. *U. S. National Bureau of Standards, Journal of Research, Section C, Engineering and Instrumentation*, v. 65C, no. 3, July-Sept. 1961, p. 165-169.

° **Coatings** Formed on Steel by Cathodic Protection and Their Evaluation by **Polarization Measurements.**– Three steel specimens were continuously exposed in the laboratory for almost five years in city water to which was added 3% by weight of NaCl. Two of these specimens were under **continuous cathodic protection,** one by current from a Zn anode, and the other by current from a rectifier through a C anode. The third specimen was left to corrode freely. As a result of the cathodic protection, carbonates and silicates formed protective coatings which eventually reduced the current density required for protection from about 5 to 0.02 ma/ft². – W. J. Schwerdtfeger and Raul J. Manuele. *U. S. National Bureau of Standards, Journal of Research, Section C, Engineering and Instrumentation*, v. 65C, no. 3, July-Sept. 1961, p. 171-181.

A New Approach to Corrosion Instrumentation for **Chemical Plant.**– A non-technical discussion of the advantages of **corrosion control** in a chemical plant by monitoring the rate of corrosion and using the signal to actuate a suitable protecting system. It is believed that the adoption of such a system would lead to an extension of the service life of plant, lessen product contamination, reduce some of the restrictions on the use of materials and on operational conditions, and, perhaps most important, lead to greater dependability and safety. – C. Edeleanu. *Industrial Chemist*, v. 37, Aug. 1961, p. 395-396.

Cheap Way to **"Mothball" Equipment.**– Burlap, double-coated with polyethylene, provide low-humidity areas for dead storage of unused equipment. – *Chemical Engineering*, v. 68, Sept. 4, 1961, p. 160 + 1 page.

Why Does **Stainless Steel** Corrode?– Authors explain why and point out the preventive measures that should be taken. – Morgan Sinclaire and Eugene Phillips. *Metal Progress*, v. 80, no. 3, Sept. 1961, p. 92-96.

° **Anodic Polarization** of Stainless Steel in **Chloride Solutions.** – Anodic polarization curves were measured on **stainless steel** electrodes in KCl solution up to 1.0N. The existence of maxima in the potential time curve was verified, and the time for the potential to decay to +0.5 v vs. SCE was measured. This depends on the time at open circuit just before measurement. For less than 3 min, it is a fuaction of this time, for more, there is no effect, at least over one order of magnitude of the applied anodic current density. The data support the view that the effect of Cl^- can be due to sorption phenomena, without assuming an oxide film. – G. M. Schmid and Norman Hackerman. *Electrochemical Society, Journal*, v. 108, Aug. 1961, p. 741-744.

Why **Boilers Corrode.** – Jeffrey Jackson. *New Scientist*, v. 11, Aug. 10, 1961, p. 333-335.

° **Corrosion Protection** for Metallic Cable Sheaths.– A description is given of the technological properties and corrosion characteristics of the materials at present used for **metallic cable sheaths.** This is followed by a discussion of the phenomena associated with the corrosion of cable sheaths and a study of the protective measures which are necessary. The results of laboratory tests on various types of corrosion protection are compared with practical experience gained in the field. – Walter Jaeschke. *Siemens Review*, v. 28, no. 8, Aug. 1961, p. 261-266.

Oxidation of **Uranium Alloys** in Carbon Dioxide and **Air.**– Additions of Ti, Mo, Nb, and Cu reduced the **attack by carbon dioxide** at 680-1000 C by factors up to 500. None of the elements was found to be markedly beneficial in CO_2 at 500 C and the Si alloys had a high rate of attack in CO_2 at most temperatures. Additions of Mo, Ti, and Nb reduced the attack in **air** at 500 C by factors up to 200. – J. E. Antill and K. A. Peakall. *Journal of the Less-Common Metals*, v. 3, no. 3, June 1961, p. 239-246.

Scaling of Chromium in a Hot Gas Stream.– The scaling behavior of **chromium** in a **hot gas stream** appears to depend on the type of flow over the metal surface, and there is evidence that the gas flow pattern could be a more important factor than the bulk gas composition. The oxide scale produced under certain conditions of gas flow provides some protection against further oxidation and nitriding. – G. R. Wilms and T. W. Rea. *Journal of the Less-Common Metals*, v. 3, no. 3, June 1961, p. 234-238.

Microstructure vs. Corrosion Resistance.– Examples are cited of the effect of composition variations and their attendent microstructures on the corrosion resistance of **stainless casting alloys, nickel-base casting alloys,** wrought **zirconium-uranium alloys,** and wrought **titanium alloys.** – W. K. Boyd and A. M. Hall. *Metals Engineering Quarterly*, v. 1, no. 3, Aug. 1961, p. 15-29.

Atmospheric Corrosion Behaviour of Two **Structural Aluminium Alloys** (H10 and H15).– **Atmospheric exposure tests** of up to 8 years' duration on low-Mn (0.04%) AW10 (HE10) and normal AW15 (HE15) Al alloys, together with supplementary laboratory tests, show that the atmospheric corrosion rate of HE10 decreases with time exponentially. After a variable incubation period, HE15 suffers exfoliation (layer) corrosion which is rapid and linear with time. Copper in the range 0.09-0.5% increases the corrosion rate of HE10 in marine atmospheres of salt spray, but has only a slight effect in a severe industrial atmosphere. There is no evidence of rapid stress-corrosion under constant-strain bending of HE10; there is, however, a very small but statistically significant increase in corrosion rate. Spraying with an anodic coating is effective in preventing both layer and short transverse stress-corrosion in HE15. – E. A. G. Liddiard and J. A. Whittaker. *Institute of Metals, Journal*, v. 89, pt. 2, July 1961, p. 423-428.

High-Temperature Oxidation of Aluminium-Magnesium Alloys in Various Gaseous Atmospheres.– The oxidation of **Al-Mg alloys** in dry and undried air and in other gases has been studied in the range 440-540 C. In dry air a parabolic rate law that quickly transforms to a linear law is followed, but in undried air different kinetics are observed. – R. A. Hine and R. D. Guminski. *Institute of Metals, Journal*, v. 89, pt. 2, July 1961, p. 417-422.

Developing **Steels** to Resist **Hydrogen Sulfide.** – Eugene Herzog. *Industrial and Engineering Chemistry*, v. 53, Sept. 1961, p. 64A-67A.

The Hot Water Corrosion Resistance of **Columbium** and Columbium Alloys.– Corrosion studies were conducted in **600 and 680 F water** and in **750 F steam** on a large number of wrought binary and ternary **columbium alloys.** The corrosion studies were supplemented with metallographic and X-ray diffraction studies. The hot water corrosion resistance of these alloys was correlated with their resistance to oxidation in air at elevated temperatures. – W. D. Klopp, W. E. Berry, and D. J. Maykuth. Paper from "Columbium Metallurgy", v. X, p. 685-718, 1961. Interscience Publishers, New York. (TN799.N7 Sy68c)

METALS—EXTRACTION AND REFINING

a Operation of the **Oxygen/Steam Blown Converters** at the VLN Steel Plant of The Steel Company of Wales Ltd.– Layout of the plant, the method adopted for lining the converter, and the manufacture of bottoms. The use of high-phosphorus Fe necessitates a double-slag process in order to ensure a steel analysis suitable for the most severe deep-drawing purposes, this grade of steel being the main product of the plant. – M. C. Harrison and P. Truscott. *Iron and Steel Institute, Journal*, v. 198, pt. 4, Aug. 1961, p. 341-352.

b Preparation of **Tungsten** and Its Alloys by **Bomb Reduction.** – Tungsten metal in fused form and of high purity was prepared by reducing tungstic oxide with redistilled Ca metal in a heavy-walled sealed reactor. Alloys of W with V, Mo, Cr, Cb, and Ta were prepared by coreduction of mixed metal oxides in the same manner. – P. C. Good, D. H. Yee, and F. E. Block. *U. S. Bureau of Mines Report of Investigations* 5828, 1961, 10 pp. (TN21 Un3r Room 290)

c ° **Heating of Ingot Heads** by Exothermic Mixtures.– The developed **exothermic mixture,** used for heating of the ingot heads, is prepared simply, is smokeless, and comparatively cheap. The use of this mixture enables the ingot crop ends to be reduced by 10-12% (when the additional filling of ingot is used). (*In Russian.*) Obogrev pribyli slitka ekzotermicheskimi smesiami. – S. P. Bakymenko, S. G. Vysotin, E. V. Verkhovtsev, A. M. Svistunov, and B. B. Guliaev. *Stal'*, v. 21, no. 7, July 1961, p. 590-598.

d ° Selection of Diameter of Self-Baking Electrodes for **Ferroalloy Smelting Furnaces.**– The practice of the Zaporozh'ie Ferroalloy Works, when melting the ferroalloys with the electrode paste consumption rate up to 8-9 kg per 100 kw hr, has revealed the possibility for **selection of electrode diameter** in accordance with the design characteristics of the furnace, and disregarding the mentioned consumption rate. (*In Russian.*) K voprosu o vybore diametra samospekaiushichikheia elektrodev ferrosplannykh pechei. – N. M. Dekhanov and B. V. Semenovich. *Stal'*, v. 21, no. 7, July 1961, p. 616-617.

e ° Use of **Exothermic Mixtures** and Inserts for Heating of Ingots.– It is most expedient to use for **heating of ingot heads** the non-thermite exothermic mixtures, composed on the base of Al, because these mixtures do not influence the composition of the metal, and their application is safe for the operators. (*In Russian.*) Primenenie ekzotermicheskikh smesei i vkladyshei dlia obogreva slitkov. – Liubomir Shmrga and Ivo Brodskii. *Stal'*, v. 21, no. 7, July 1961, p. 598-604.

f The Use of Castables in Repairing **Blast Furnace Linings.**– Use of **isotopes** can check **condition of refractory** during operation. – A. Eugene Frey. *Iron and Steel Engineer*, v. 38, Aug. 1961, p. 120-124.

g **Refining Lead.**– Survey of methods for the **removal of Bi.** – J. F. Holmes. *Metal Industry*, v. 99, Aug. 11, 1961, p. 110-112.

h ° Heating an **Open-Hearth Furnace** With a Mixture of Coke Oven Gas and Natural Gas.– By means of these gases it becomes possible to use the excesses of **coke oven gas** liberated during the passage of the furnace to **natural gas.** The melting time is reduced by 6.6%, the melting process and the finishing period by 4.8%, the fuel consumption by 6.86% as compared with heating with a coke-blast furnace mixture. The adaption of open-hearth furnace to the new method is inexpensive and does not require any special equipment. (*In Russian.*) Otoplenie martenovskoĭ pechi smes'iu koksovogo i prirodnogo gazov. – M. M. Khil'ko and M. S. Shkliar. *Metallurg*, v. 6, no. 7, July 1961, p. 11-13.

i Production of **Plutonium** Metal.– Use of heavy water moderated reactors fueled with natural U followed by the **Purex process** (solvent extraction) to separate Pu from spent fuel elements. – Elspeth W. Mainland, editor. *Industrial and Engineering Chemistry*, v. 53, Sept. 1961, p. 685-694.

j Activities in **Lime-Alumina Melts.**– Measurements have been made of sulphide capacities and of the limiting **solubilities of calcium sulphide** in melts containing lime and alumina at 1500 C. A gas+slag equilibrium technique was employed. From

these results, and thermal data concerning crystalline calcium aluminates, the activities of lime and alumina have been obtained over the whole liquid range. – R. A. Sharma and F. D. Richardson. *Iron and Steel Institute, Journal*, v. 198, pt. 4, Aug. 1961, p. 386-390.

Low Pressure Metallurgy. The Reduction of Oxides by Carbon.– Factors affecting the progress of **reduction,** including metal-crucible reactions. – A. S. Darling. *Metallurgia*, v. 64, July 1961, p. 7-13.

• Contributions to the Kinetics of the Deoxidation of **Molten Iron.**– Studies theoretically the nucleation and the growth determined by diffusion during the precipitation **deoxidation** in molten steel on the basis of a literature survey. Describes solution tests with Zr as the deoxidizer, the effects of the O contents of the melt on the solution, deoxidation tests with Zr to determine the concentration of Zr and O at the point of reaction. Determines the **supersaturation before nucleation.** (*In German.*) Beiträge zur Kinetik der Desoxydation flüssigen Eisens. – Ludwig von Bogdandy, Wolfgang Meyer, and Iwan N. Stranski. *Archiv für das Eisenhüttenwesen*, v. 32, no. 7, July 1961, p. 451-460.

METALS—FINISHING, POLISHING, AND CLEANING

• Pre-Treatment of Metals.– The various methods of **cleaning** and **pretreating** metals prior to painting or plating are reviewed. Emphasis is placed on the importance of correct and thorough pretreatment in order to obtain a good and lasting finish. – J. Q. Radcliffe. *Product Finishing*, v. 14, Aug. 1961, p. 72-76.

Electrolytic Cleaning.– Brief account of the techniques used in current practice. – J. Q. Radcliffe. *Industrial Finishing (London)*, v. 13, Aug. 1961, p. 33 + 1 page.

• **New Descaling Method** Cuts Surface Attack on Super Alloys; Saves Costs, Manhours.– The sodium hydride RW 77 process reduces **intergranular surface attack** on super alloys and **stainless steels** used in the aircraft and missile industry. It will not deter or interfere with fatigue life of the metal in its optimum condition. The new process doesn't require heat, automatically eliminating close adjustments, controls and expensive ventilation systems, which results in less equipment maintenance. – *Western Metalworking*, v. 19, Sept. 1961, p. 39-40.

METALS—FOUNDRY PRACTICE

• **Aluminium Castings** for Anodic Oxidation.– The importance of the production of Al castings anodized for decorative purposes is shown by examples, and the appropriate alloys are indicated. Defects due to melting and casting errors and means of avoiding them. A few principles of **gating** and **feeding** are explained. – E. A. Bloch. *Foundry Trade Journal*, v. 3, Aug. 10, 1961, p. 161-165.

Risering. Permanent Mold **Aluminum Alloy Castings.**– **Risers** in **permanent molds** act as vents for the mold cavity as well as supply feed metal. Riser, ingate, and nozzle relationships are discussed. A redesigned **gating system** is suggested. – George A. Bier. *Foundry*, v. 89, Sept. 1961, p. 71-73.

• **Solidification** of Steel Castings and Ingots.– Summarizes results on solidification of high-strength low-alloy steel. Main emphasis on examining different methods of obtaining directional solidification in **cast steel,** and effects of solidification variables on structure, segregation, and properties of the cast steel. – M. C. Flemings, R. V. Barone, S. Z. Uram, and H. F. Taylor. *Modern Castings*, v. 40, Sept. 1961, p. 82-95.

• **Fin Gating**–New Cost-Cutting **Steel** Technique. – *Modern Castings*, v. 40, Sept. 1961, p. 53-55.

• **Precision Cores** Obtained by Using New Synthetic Resins and Traditional Equipment.– Describes the new **Peugeot-Bakelite process** whose special advantages are: easy preparation of sand

with optimum characteristics in operation and adaptability in production, precise dimensions, elimination of core correction operations, reduction of the firing time, prolonged storage time, and increase in precision of core assembling. (*In Italian.*) Con l'impiego di nuove resine sintetiche e utilizzando le attrezzature tradizionali si ottengono anime precise. – M. Jacques Roth. *Fonderia*, v. 10, July 1961, p. 279-288.

• **Vacuum Casting.**– Bristol Siddeley have been vacuum casting about 1.5 to 2 tons of Vacumelt G64 **nickel-base superalloy** a week by the **investment casting** process for the past year and are well to the fore in progress and experience. – David Fishlock. *Metalworking Production*, v. 105, no. 31, Aug. 2, 1961, p. 49-53.

Casting Small Parts of **Refractory Metals.**– A new method has been developed specifically for casting small **titanium parts** which offers several advantages over processes used to produce larger castings. – A. R. C. Westwood. *Foundry*, v. 89, July 1961, p. 68-71.

METALS—HEAT TREATMENT

• Heat Treating Teams With Brazing.– By **combining brazing and heat treating,** it is possible to minimize metallurgical defects in high-strength, heat-resistant alloys and resultant dimensional instability in finished parts. – John J. Lawless, Jr. *American Machinist*, v. 105, Aug. 21, 1961, p. 101-103.

• How to **Induction Harden Axle Spindles.** – Ed Nugent. *Canadian Metalworking*, v. 24, Aug. 1961, p. 60-61.

• **'Nitriding'** in a Salt Bath.– **Salt bath heat-treatment** that bolsters the wear and fatigue strengths and hardness of low-cost steels. Called "tufftriding", the process is akin to nitriding inasmuch as there's nitrogen pick-up by the steel. – *Metalworking Production*, v. 105, no. 32, Aug. 9, 1961, p. 43.

• **Flame Hardening** of **Camshafts.**– Considerations of component design and burner arrangement for rapid and economical production by the spin-hardening method. – H. W. Grönegress. *Automobile Engineer*, v. 51, Aug. 1961, p. 320-324.

• Avoidance of **Distortion** in **Heat Treatment.**– Change in volume, change in shape, and warping; their characteristics, causes, and prevention. – K. Sachs. *Metal Treatment and Drop Forging*, v. 28, Aug. 1961, p. 317 + 7 pages.

METALS—MECHANICAL AND PHYSICAL PROPERTIES

• An Investigation of the Plastic Deformation of a **Metal** Having Some **Deformation Anisotropy** Created by Preliminary Loading.– The development of plastic deformations was investigated at the initial stage of reiterative material loads partially or totally unloaded subsequently to the first **plastic deformation.** (*In Russian.*) Izuchenie plasticheskofo deformurovaniia metalla s deformatsionnoi anizotropiei sozdannoi v protsesse predvarilel'nogo nafruzheniia – I. N. Izotov and Iu. I. Iagn. *Akademiia Nauk SSSR, Doklady*, v. 139, no. 3, July 21, 1961, p. 576-579.

• **Density** of **Molten Silicon Alloys** With Cobalt and Nickel.– Describes relationships with concentration. The changes observed were related to the change of the coordination of the atoms and the nature of the reactions between the particles. The **volume characteristics** of the alloys suggested the presence of a structural inhomogeneity in the liquid state. (*In Russian.*) Plotnosti zhidkikh splavov kremniia s kobaltom i nikelem. – P. V. Geld and Iu. M. Gertman. *Fizika Metallov i Metallovedenie*, v. 12, no. 1, July 1961, p. 47-50 + 2 plates.

Non-Basal Slip and Twin Accommodation in **Zinc Crystals.** – Etch pit technique was used. It was confirmed that at room temperature **nonbasal slip** occurs on the $\{ 11\bar{2}2 \}$ pyramidal planes. Observations were made on $\{ 10\bar{1}2 \}$ mechanical

twins that go partially through the crystal. – H. S. Rosenbaum. *Acta Metallurgica*, v. 9, Aug. 1961, p. 742-748.

Mechanical Properties of an **Iron-Carbon Alloy** During Allotropic Transformation.– Measurements of the **angular twists** obtained by **transforming the alloy** under different torsional moments are presented. – M. de Jong and G. W. Rathenau. *Acta Metallurgica*, v. 9, Aug. 1961, p. 714-720.

* Effects of Chemical Composition on the Mechanical Properties of **Non-Quenched Medium Alloyed Steel.**– Examines the **mechanical properties** of experimental steels obtained by the electroslag method, upset 3.5 times and thermally treated. Owing to a multicomponent alloying process, it is possible to obtain high strength with sufficient plasticity and toughness of a metal containing as much as 0.20% C. (*In Russian.*) Vliianie khimicheskogo sostava na mekhanicheskie svoĭstva nezakalennykh srednelegirovannykh staleĭ. – T. M. Slutskaia and N. A. Mosendz. *Avtomaticheskaia Svarka*, v. 14, no. 8(101), Aug. 1961, p. 20-24.

* Effect of Sulfonation on Metal **Wear Resistance.**– Investigates durability, scoring resistance, **sulfonation** depth, surface purity, magnitude and character of wear product of sulfonated parts at various specific pressures and rates of slipping. (*In Russian.*) Vliianie sul'fidirovaniia na iznos metallov. – A. N. Tynnyi. *Metallovedenie i Termicheskaia Obrabotka Metallov*, 1961, no. 8, Aug., p. 15-18.

Strengthening of **Iron-Base Alloys Containing Columbium.**– Columbium, C, and Ni additions were made to Fe-base alloys with 20% Cr. The effetcs on microstructure, precipitation-hardening characteristics, and high-temperature properties were investigated by means of metallographic, hot-hardness, and magnetic measurements. An austenitic alloy consisting of Fe-20Cr-14Ni-0.8C-2.5Cb had higher hot-hardness at 1700 F than the other alloys investigated. Its favorable standing is attributed to an enhanced interaction of Cb and Cr_4C particles dispersed within a stable austenitic matrix. – E. E. Underwood, E. M. Stein, and G. K. Manning. *American Institute of Mining, Metallurgical and Petroleum Engineers, Transactions, Metallurgical Society*, v. 221, no. 4, Aug. 1961, p. 676-682.

* Influence of **Heating Conditions** of Slabs on Electromagnetic Properties of Transformer Steel Sheets.– Increasing the period of heating and raising the temperature of the **transformer steel** slabs before their rolling substantially improves the **electromagnetic properties** of the finished sheets, and particularly of the sheets with a thickness of 0.35 mm. (*In Russian.*) Vliianie nagreva slabov na elektromagnitnye svoistva transformatornogo lista. – A. I. Beliakov and F. D. Ivanov. *Stal'*, v. 21, no. 7, July 1961, p. 634-637.

The **Emittance of Iron,** Nickel, and Cobalt and Their Alloys.– Curves showing normal total emittance of temperature are given for solid and molten iron and for various alloys including **Nichrome, Inconel, Nionel, Haynes,** and **Nimonic types.** – W. D. Wood, H. W. Deem, and C. F. Lucks. *Battelle Memorial Institute, Defense Metals Information Center, DMIC Memorandum* 119, July 25, 1961, 82 pp. (TN799 B32.2d Contin.)

Investigation of **Delayed-Cracking** Phenomenon in **Hydrogenated Unalloyed Titanium.**– Indicates that strain-aging embrittlement does not occur in unalloyed Ti having up to 0.38 wt.% O content with as much as 160 ppm H content. However, a noticeable effect of H on notch sensitivity of the materials, in the alpha-annealed and especially in the beta-annealed conditions, was observed. – R. A. Wood, D. N. Williams, and H. R. Ogden. *Battelle Memorial Institute, Defense Metals Information Center, DMIC Memorandum* 124, Aug. 30, 1961, 18 pp. (TN799 B32.2d Contin.)

* X-Ray Investigation on the **Fatigue Damage** of Metals.– Fatigue process is studied by observing the half-value breadth of the **X-ray diffraction** lines taken from (310) atomic plane with C K_α radiation, which were obtained from the specimens of carbon **steel wire, cast iron** and cast steel stressed alternately **in rotary bending.** – Shuji Taira and Kazuo Honda. *Bulletin of JSME*, v. 4, no. 14, May 1961, p. 230-237.

Ductility in Internally Oxidised **Silver Alloys.**– **Intergranular brittleness** associated with internally oxidized binary alloys of Ag with Al is suppressed when small quantities of **Ni or Co** are present. Tensile properties and hardness of such alloys have been measured, and metallographic evidence suggests that the addition of the third element reduces the grain-boundary precipitate on internal oxidation. The necessary conditions for such suppression are briefly discussed. – J. A. Slade and J. W. Martin. *Metallurgia*, v. 64, July 1961, p. 23-25.

The Fabrication and **Mechanical Properties** of Some **Columbium Alloys** for Use in Pressurized Water Reactors.– A number of binary and ternary alloys of interest in an alloy development program for **pressurized-water reactor applications** were prepared, using an electron-beam-refined Cb base, by arc melting and fabricated to sheet. The comparative **fabricabilities** of these alloys and their hardnesses, tensile, creep, and stress-rupture properties at temperatures up through 1500 F are discussed. – D. J. Maykuth and R. I. Jaffee. Paper from "Columbium Metallurgy", v. X, p. 223-256, 1961. Interscience Publishers, New York. (TN799.N7 Sy68c)

High Strength Zirconium-Base Alloys.– **Mechanical and corrosion properties** of certain **high-strength zirconium alloys** for possible use as structural or **fuel element cladding materials.** – G. A. Henrikson. *U. S. Atomic Energy Commission, NMI*-1244, Feb. 22, 1961, 26 pp. (UF767 Un3.1nm Contin.)

* **Surface Tension** of **Molten Iron** and Its Alloys. I. Experimental Technique and Results for Pure Iron at 1550°C.– Measurements were made by the supported drop test. The atmosphere in the measuring apparatus was checked by means of a direct test which permitted determination of approximately 10^{-15} atm. of O_2. The capillary constant was found to be 26.0 mm^2; for $d = 7.01$, this gives $\gamma = 1788$ dyn/cm. (*In French.*) Tension superficielle du fer liquide et de ses alliages. I. Technique expérimentale et les résultats sur le fer pur a 1 550°C. – Paul Kozakevitch and Georges Urbain. *Revue de Métallurgie, Mémoires Scientifiques*, v. 58, no. 6, June 1961, p. 401-413.

METALS—MECHANICAL WORKING

Fabricating and Machining Practices for the All-Beta **Titanium Alloy (Ti-13V-11Cr-3Al).**– Brief review of information available to the Defense Metals Information Center prior to May 15, 1961. – C. T. Olofson and F. W. Boulger. *Battelle Memorial Institute, Defense Metals Information Center, DMIC Memorandum* 121, Aug. 3, 1961, 8 pp. (TN799 B32.2d Contin.)

Theory of **Metal Cutting.**– Covers basic principles of friction, lubrication, and wear; cutting fluids and tools; tool life; grinding of metal; three-dimensional cutting; unconventional methods; and economics of machining. – Paul H. Black. 204 pp. 1961. McGraw-Hill, New York. (TJ1180 B56t)

* Metallurgical Aspects of the **Cold Extrusion** of **Steel.**– Considers the effect of extrusion on the metallic materials involved at various stages of the process, the ways of bringing these materials to a condition suitable for working, and the effects of the extrusion process on later treatments. Side by side with these conditions the factors defining the practical limitations are indicated. – R. E. Okell. *Metal Treatment and Drop Forging*, v. 28, Aug. 1961, p. 309-316.

* Pressure of Metal on Rolls of **Bending and Shaping Mills.**– **Pressure measurements** enabled the required capacity of the mills to be determined. (*In Russian.*) Davlenie metala na valki profilegibochnykh stanov. – T. K. Aleksandrova, A. A. Nikozov, and V. A. Gamershtein. *Stal'*, v. 21, no. 7, July 1961, p. 618-621.

* **Roll-Pass Designing** According to Method of Deflection for Rolling Channels in **550-mm Mill.**– The use of the developed roll-passes, designed according to the method of deflection for rolling the channels, enabled the spacing of the grooves on the barrel length to be improved, the roll consumption rate to be greatly reduced, the working conditions to be improved, and an increased output of the mill to be attained (when the weight per running meter of channel was reduced). (*In Russian.*) Kalibrovka shvellera na stane 550 po metodu sgibaniia. – B. M. Iliukovich. *Stal'*, v. 21, no. 7, July 1961, p. 621-626.

How AC Spark Plug **Machines Beryllium.** – *Steel*, v. 149, Aug. 28, 1961, p. 70-73.

Cold Stretch for Stronger Process Units.– Report on **cold-stretching** technique (Ardeforming) for making lower cost **stainless-steel pressure vessels.** – *Chemical Week*, v. 89, no. 9, Sept. 2, 1961, p. 57 + 2 pages.

• **Cold Extrusion**--A Review of Some Technical Information and Current Practice. – D. F. Galloway. *Microtecnic* (English Edition), v. 15, no. 3, June 1961, p. 85-103.

Fabrication of **Columbium Alloy Castings** at Low Temperatures.– Fabrication is discussed in detail; the alloys to which this technique is applicable were predicted. – J. A. DeMastry and E. L. Foster. Paper from "Columbium Metallurgy", v. X, p. 75-83, 1961. Interscience Publishers, New York. (TN799.N7 Sy68c)

• Progress Report on **Molybdenum Disulfide** as a **Copper and Copper Alloy Drawing Lubricant.** – Peter M. Magie. *Wire and Wire Products*, v. 36, Aug. 1961, p. 995 + 4 pages.

Forming at Austenitizing Temperatures for Distortion Control During Heat Treating.– Thin-gage sheet metal parts of **martensitic stainless steels** are simultaneously heat treated and formed at austenitic temperatures for distortion control using conventional furnaces, special salt baths, and electrical resistance-heating apparatus in combination with special and conventional presses. – R. B. Cantley. *Metals Engineering Quarterly*, v. 1, no. 3, Aug. 1961, p. 3-6.

Cutting Tools, Jigs and Fixtures.– Surveys developments during recent years in the various types of cutting tools, especially ceramic and diamond tools. The basic features of tool design are considered, including such matters as negative-rake cutting for the efficient utilization of cemented carbide tools, and the design of cutters for down-cut milling and square-hole drilling. Heat-treatment, tool-grinding, cutting speeds and feed rates, and form-tool design and calculations are included. – H. C. Town. 247 pp. 1960. MacMillan Co., New York. (TJ1186 T66c)

• Digital Position Control for the Shear Gauge of a Light-Section **Rolling Mill.**– A **digital position control** constructed of Simatic components has been developed for the shear gauge of a light-section rolling mill, which, apart from effecting an appreciable improvement in the cutting accuracy, operates with practically no wear and thus requires little maintenance. These advantages are afforded by the use of contactless control gear. Provision can be made for automatic positioning or for automatic correction of the shrinkage. – Friedrich Fröhr and Reinhold Schmidt. *Siemens Review*, v. 28, no. 8, Aug. 1961, p. 272-275.

The Effects of Temper Rolling and Strain Ageing on the Formability of **Low-Carbon Steel.**– Influence of temper rolling and strain aging on the **forming behavior** of low-carbon rimming steel sheets has been studied in uniaxial tension, biaxial stretch-forming, and deep drawing tests. – D. V. Wilson, R. D. Butler, and B. B. Moreton. *Iron and Steel Institute, Journal*, v. 198, pt. 4, Aug. 1961, p. 376-386.

Tools for **Heavy Forging** Work. – R. C. Benson and R. J. H. Hunt. *Iron and Steel Institute, Journal*, v. 198, pt. 4, Aug. 1961, p. 390-401.

• On **Surface Finish** Produced by Ceramic Tools.– Deals with the roughness and property of surface produced by **ceramic tools** in comparison with those produced by **carbide tools.** – Keiji Okushima and Yoshiya Fujii. *Bulletin of JSME*, v. 4, no. 14, May 1961, p. 365-374.

Hydraulic **Stretch Forming** Machines.– Discussion of section stretchers, plate stretchers, auxiliary equipment, and drives and controls. – Walter Dohrn and Heinrich Sandherm. *Light Metal Age*, v. 19, Aug. 1961, p. 11-15.

METALS—METALLOGRAPHY, TRANSFORMATIONS, AND STRUCTURES

Quantitative Metallography.– Discusses advantages of three-dimensional parameters to characterize behavior of alloys. Describes quantitative measurement of volume fraction of some or all the constituents of an alloy by areal analysis, lineal analysis, and point counting. Gives exact and approximate methods for determining the boundary area of grains, phases, and other structural components. – Ervin E. Underwood. *Metals Engineering Quarterly*, v. 1, no. 3, Aug. 1961, p. 70-81.

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A High Temperature X-Ray Study of **Ordering** in Iron-Aluminium Alloys.– Variation with temperature of long-range order in **iron-aluminum solid solutions** was studied, using a high-temperature diffractometer, and short-range order was studied at room temperature by measuring diffusely scattered X-rays. – A. Lawley and R. W. Cahn. *Physics and Chemistry of Solids*, v. 20, nos. 3-4, Aug. 1961, p. 204-221 + 1 plate.

b

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Diffusion Along Small-Angle Grain Boundaries in **Silicon.**– Means of studying the effect of **dislocations** upon the **diffusion** of solute atoms in crystals. – H. J. Queisser, K. Hubner, and W. Shockley. *Physical Review*, v. 123, 2nd ser., no. 4, Aug. 15, 1961, p. 1245-1254.

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Our new format should help you scan the page quickly. Boldface clue words identify subject matter. Titles appear unchanged at the beginning of each abstract.

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Work-Hardening of **Hexagonal Close-Packed Crystals** and in the Easy Glide Region of **Face-Centred Cubic Crystals.**– New experimental results are reported on **copper** single crystals deformed at liquid O temperature. A dislocation theory of **work-hardening** is given which accounts rather well for the experimental facts. The work-hardening rate can be calculated from slip-line data (distances between and lengths of slip-lines) is found to agree well with the measurements. The theory is statistical. – A. Seeger, H. Kronmüller, S. Mader, and H. Träuble. *Philosophical Magazine*, v. 6, ser. 8, May 1961, p. 639-655.

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Grain-Boundary Diffusion.– The diffusion of **nickel** into grain boundaries of various tilt angles in **copper** bicrystals was studied. The concentration contours from the grain boundary and the lateral lattice diffusion were measured by means of electron-probe microanalysis. The product of grain-boundary width and diffusion coefficient were calculated, and comparisons were made with theoretical solutions. The grain-boundary coefficient is concentration dependent above 3% nickel in a 45° tilt boundary. With lower tilt angles, the coefficient is concentration dependent above 0.5% nickel. – A. E. Austin and N. A. Richard. *Journal of Applied Physics*, v. 32, Aug. 1961, p. 1462-1471.

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Surface **Self Diffusion Measurements** on Nickel by the Mass Transfer Method.– Constants D_s for **Ni,** heated *in vacuo* at temperatures between 800 C and 1200 C were calculated from interferometric measurements on the rate of smoothing of scratches, and were found to depend strongly on surface orientation, the effect being greatest at the lower temperatures. – J. M. Blakely and H. Mykura. *Acta Metallurgica*, v. 9, Jan. 1961, p. 23-31.

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• Self-Diffusion in Body-Centered Cubic **Zirconium.**– **Self-diffusion** coefficients of crystal-bar Zr were measured between 1500 C and 1100 C, using radioactive Zr^{95} as a tracer. – G. Kidson and J. McGurn. *Canadian Journal of Physics*, v. 39, Aug. 1961, p. 1146-1157.

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• The Iron Side of the **Iron-Zinc System.**– By diffusion tests, microscopic investigations, and radiographic high temperature examinations, the appearing of an **enlarged α-field** and of a contracted γ-field was confirmed. Furthermore, it was revealed that in Fe, dissolved metals of two types widen the α-region. (*In German.*) Die Eisenseite des Systems Eisen-Zink. – H. H. Stadelmaier and R. K. Bridgers. *Metall*, v. 15, Aug. 1961, p. 761-763.

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• Interaction Between the **Nitrogen Atoms** and the Dislocations During Aging Through Strain Hardening.– In pure molten Fe in a vacuum, the effects of the fields of **strain** of the **dislocations** on the time of relaxation of the internal friction connected with the displacement of interstitial atoms in the cubic centered lattice were studied. The negative lattice implies that the

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passage of a completely disordered solution to a compact arrangement in the atmospheres of dislocation must occur by a few displacements of atoms. (*In French.*) Interaction entre les atomes d'azote et les dislocations pendant le vieillissement par écrouissage. – G. M. Leak. *Métaux Corrosion-Industries*, v. 36, June 1961, p. 232-234.

• **Boron Diffusion** in Silicon.– The diffusion of boron in **silicon** has been investigated by a p-n junction method over the temperature range of 1050-1350 C and in silicon material where the n-type impurity density varied over a range $2x10^{15}$ to $8x10^{19}$ at./cm³. – E. L. Williams. *Electrochemical Society, Journal*, v. 108, Aug. 1961, p. 795-798.

• Effect of Solute Atoms on **Grain Boundary Migration** in Pure Metals. – E. L. Holmes and W. C. Winegard. *Canadian Journal of Physics*, v. 39, Aug. 1961, p. 1223-1226.

Self-Diffusion in 50-50 **Gold-Cadmium.**– From 300 to 590 C the results are well fitted by values $Q = 28.0$ kcal/mole and $D_o = 0.23$ cm²/sec for Cd and $Q = 27.9$ kcal/mole and $D_o = 0.17$ cm²/sec for Au. Between 590 C and the melting point at 626 C there is a marked upward curvature in both diffusion plots. The **ratio of the diffusivities** is roughly 4:3 throughout and is consistent with a mechanism of nearest neighbor vacancy jumping. The **activation energies** for diffusion exceed the sum of energies for vacancy formation and motion previously reported. Two possible explanations for this discrepancy are suggested. – H. B. Huntington, N. C. Miller, and V. Nerses. *Acta Metallurgica*, v. 9, Aug. 1961, p. 749-753.

Substructure Formation in **Iron During Creep** at 600°C.– **Structural changes** in iron under constant stresses of 176 and 550 kg/cm² were investigated by means of several different techniques, including metallographic examination, high resolution X-ray methods and transmission electron microscopy. – F. Garofalo, L. Zwell, A. S. Keh, and S. Weissmann. *Acta Metallurgica*, v. 9, Aug. 1961, p. 721-729.

Effects of **Annealing** Under High Pressures on **Dislocations** in **Lithium Fluoride, Aluminum, Copper and Iron.**– Single crystals of LiF, Al, Cu, and Fe have been annealed for 1 hr at 500-600 C under a pressure of 40 kb. The dislocation structure was studied, before and after treatment, by the Berg-Barrett X-ray technique in Al and by etch pitting in the other materials. –J. E. Hilliard, J. M. Lommel, J. B. Hudson, D. F. Stein, and J. D. Livingston. *Acta Metallurgica*, v. 9, Aug. 1961, p. 787-794.

METALS—POWDER

• **Dispersion-Strengthened Aluminium Alloys.**– Theoretical interpretation of relationships between structure and properties. Application of this knowledge to development of further new types of materials. – E. A. Bloch. *Metallurgical Reviews*, v. 6, no. 22, 1961, p. 193-239 + 12 plates.

• **Sintered Steel.**– Composition and properties, applications, and cost of forging and machining sintered nickel steel. – *Metalworking Production*, v. 105, no. 32, Aug. 9, 1961, p. 46-47.

• **Wire as Starting Material** for Spherical Powders of Metals and Alloys Developed by Union Carbide Corporation.– A process for producing **spherical powders of metals** and metal alloys with particles ranging in size from 20 to 150 microns with a uniformity rate of 98%. – *Wire*, no. 54, Aug. 1961, p. 117.

NONDESTRUCTIVE TESTING AND QUALITY CONTROL

• **Measuring Thickness and Density** by Means of **Radio-Active Beams.**– Constant measuring of thickness, density, or surface mass of products at the production machines themselves has, on account of the steadily growing speed of production, become in certain cases a matter of dire necessity. To measure these values, devices for **non-contact gauging** of the products by application of the radiation of radioactive material have been

used in industry both at home and abroad for the past ten to fifteen years. In non-contact gauging the objects to be measured are neither damaged nor changed. (*In German.*) Dicken- und Dichtemessungen mit radioaktiven Strahlen. – Kurt Herlitze. *VDI Zeitschrift*, v. 103, no. 23, Aug. 1961, p. 1154-1162.

a

• A **Castings** User Looks at **Quality Control.**– The expense of installing an effective quality control system will be returned several times over through reduced scrap and an improved competitive position. Such a system requires a careful plan of inspection coverage, execution of the plan, and conscientious follow-up. – Harry S. Kindle, Jr. *Foundry*, v. 89, July 1961, p. 62-64.

b

• Making Efficient Use of **Magnetic Particle Inspection.**– Outlines one **foundry's experience.** – Paul E. Eubanks. *Foundry*, v. 89, July 1961, p. 106 + 2 pages.

c

• **Magnetic Particle Testing** of Brazed Joints in Nonmagnetic Stainless.– A new spray-on inspection system which depends on **brazing alloys** to change their magnetic properties after brazing. The system also provides a permanent record on plastic film. – Maxwell Pevar. *Welding Design & Fabrication*, v. 34, July 1961, p. 62-63.

d

• **Alpha Particle Thickness Gauge** Using a Solid State Detector. – An alpha particle thickness gauge is described in which the shift in energy of α-particles in passing through the material is observed directly by means of a **solid state detector** and **pulse height analyzer.** Measurements of the thickness of 1 mg/cm² foils can be made easily to better than 1%. The arrangement is useful for absolute energy loss measurements and some results are given for mylar. – Herbert L. Anderson. *Nuclear Instruments and Methods*, v. 12, June 1961, p. 111-114.

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• Closely-Defined **Magnetic Field** Measures **Wear** on Metal Surfaces. – F. H. Baer. *Electronics*, v. 34, no. 29, July 21, 1961, p. 26-27.

• A New Technique in **Aircraft Radiography.**– Describes how Convair-San Diego achieved a considerable cost reduction and subsequent savings in radiographic inspection of the Convair 880 and 990. – G. R. Bailey. *Nondestructive Testing*, v. 19, no. 4, July-Aug. 1961, p. 274-275.

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• **Radiographic** and **Polarographic** Testing of **Electronic Components.**– The particular system under consideration is basically a folded-tree modified digital computer, the relay channels addresses and commands into the appropriate programming modules. Failure results in a "no-go" reading which implies a malfunction where none may actually exist. – S. DiLauro and F. P. Kiefer. *Nondestructive Testing*, v. 19, no. 4, July-Aug. 1961, p. 261-263.

g

• **Symposium** on Physics and Nondestructive Testing. Held at Argonne National Laboratory, Oct. 4-5, 1960.– Covers **neutron radiography,** usage of solid state devices, **ultrasonic attentuation,** ultrasonic wave transmission, lamb waves, diffusion of pulsed current fields in conductors, magnetic properties of reactor metals and alloys, mathematics and statistical methods of nondestructive testing, and application of **particle accelerators** to nondestructive testing. *U. S. Atomic Energy Commission, ANL-6346*, 207 pp. (UF767 Un3.1an Contin.)

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Fluoroscopic Methods of **Weld Evaluation.**– Results which can be expected with currently available image-forming systems. – Otto Renius and D. W. Bowman. *Welding and Metal Fabrication*, v. 29, Aug. 1961, p. 341-343.

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• Non-Destructive Method of Gauging **Electrodeposited Nickel** Layers.– An **instrument for gauging** electrodeposited Ni layers within the thickness range 0.2 mil to at least 1.5 mil is described. It utilizes the local thermal emfs set up when a heated metal probe is brought into contact with the coating. The influence of the differing thermoelectric properties of various commercial Ni deposits upon the accuracy of measurement has been evaluated. – P. M. Reynolds. *Journal of Scientific Instruments*, v. 38, Aug. 1961, p. 313-317.

j

Radioactive Testing of **Accelerometer** Takes Two Large Facilities.– Lists questions instrument designers must answer as they deal with the new requirements of **nuclear environments.** – Dale C. Baker. *Space/Aeronautics*, v. 36, no. 2, Aug. 1961, p. 85 + 3 pages.

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NUCLEAR PHYSICS, NUCLEONICS, AND RADIATION

Development of Dilute **Plutonium Alloys.**– Plutonium is being studied as a substitute fuel for U-235 in alloys for high-temperature use and for "spike" elements in power reactors. Alloys being studied include Nb-Pu, Ni-Pu-Si, Ni-Pu-Zr, Th-Pu, and Th-Pu-Zr. – Victor W. Storhok, Arthur A. Bauer, and Ronald F. Dickerson. *U. S. Atomic Energy Commission, BMI-1532*, July 27, 1961, 24 pp. (UF767 U3b Contin.)

Progress Relating to Civilian Applications During May, 1961. – Gives status of work being done at Battelle on **reactor materials and components,** studies of fuels, general **fuel-element** development, development of **uranium carbide,** radioisotope and radiation applications, coated particle fuel materials, problems associated with the recovery of spent reactor fuel elements, and development of fabrication processes for **cold bonding** of Zircaloy-2 to type 410 stainless steel. – Russell W. Dayton and Clyde R. Tipton, Jr. *U. S. Atomic Energy Commission, BMI-1518* (Del.) June 1, 1961, 96 pp. (UF767 U3b Contin.)

MTR Thermal Neutron Flux Measurements for Cycle 146.– Measurements include data for a clean core Cycle 146C (0 MWD), depleted core Cycle 146A (564 MWD), and an integrated core (394 MWD). Vertical traverses for each position monitored are shown. Measured Cd ratios for "thin" Co in various positions are included. – L. D. Weber and C. H. Hogg. *U. S. Atomic Energy Commission, IDO-16657*, May 31, 1961, 90 pp. (UF767 Un3.1id Contin.)

* Reactions in the **A = 4 System.** III. $T(p,n)$.– An analysis is presented of the **charge exchange reaction T(p, n).** – James E. Young and Paul R. Stein. *Annals of Physics*, v. 15, Aug. 1961, p. 157-192.

* On the Deuteron as a **Free Nucleon Target** at 145 Mev.– The quasielastic p--p scattering in the deuteron has been studied at 145 Mev. Cross sections and asymmetries in a polarized beam have been measured. It is shown that the extrapolation procedure suggested by Chew and Low can be qualitatively used to relate the results. The use of the **extrapolation procedure** in other similar cases is discussed. – A. F. Kuckes, Richard Wilson, and Paul F. Cooper, Jr. *Annals of Physics*, v. 15, Aug. 1961, p. 193-222.

Nuclear Alinement of Cobalt and the Decay of **Cobalt-55.** – C. J. S. Chapman, J. M. Gregory, R. W. Hill, and M. W. Johns. *Royal Society, Proceedings*, v. 262, ser. A, Aug. 8, 1961, p. 541-554.

Xenon Diffusion in Single-Crystal and Sintered UO_2.– Diffusion was studied by short-time neutron activation and subsequent heating. It was found that diffusion rates in **UO_2 single crystals** at 1400 C are about two orders of magnitude lower than for **sintered UO_2 materials.** It is believed that this difference is associated with the presence of fewer defects in the single-crystal materials, probably as a result of the lower metallic-impurity content and greater crystalline perfection. No grain-boundary effects were observed for specimens having 2.2- and 23.7-μ grain sizes. – Russell H. Barnes, Mihkel Kangilaski, James B. Melehan, and Frank A. Rough. *U. S. Atomic Energy Commission, BMI-1533*, Aug. 1, 1961, 40 pp. (UF767 U3b Contin.)

* The **Electron-Neutrino Angular Correlation** in Beta Decay of Helium 6.– **Decay of He^6** has been determined by measuring the distribution of electron energies and recoil velocities without selection of angle. – B. W. Ridley. *Nuclear Physics*, v. 25, no. 3, June 1961, p. 483-501.

* The Gyromagnetic Ratio of the 155 keV-**Rotational Level** in **Os^{188}**.– A 4-channel coincidence apparatus was used to investigate the influence of an external magnetic field on the angular correlation of the 931-155 keV cascade in Os^{188}. The strength of the **magnetic interaction** was found. – E. Karlsson, C.-A. Lerjefors, and E. Matthias. *Nuclear Physics*, v. 25, no. 3, June 1961, p. 385-403.

The Development of Cascades Initiated by **Nuclear Interaction.**– The distribution function describing the development of **electromagnetic cascades** has been derived under the assumption that the primary particles are γ-rays with a certain energy spectrum and angular spread. By comparing experimental results on the lateral distribution of electrons in cascades initiated by nuclear interactions with the calculations presented here one may obtain information on some characteristic features of 'jets'. – K. Pinkau. *Philosophical Magazine*, v. 6, ser. 8, May 1961, p. 657-667.

Pion Production and the Second **Pion-Nucleon Resonance.**– A model for the reaction $\pi+N\rightarrow 2\pi+N$ at low energies, which includes pion-pion interaction and final-state interactions in the (3,3) state, is discussed. The theory involves 2 parameters which are related to the S-wave and P-wave π-π scattering lengths. – Charles J. Goebel and Howard J. Schnitzer. *Physical Review*, v. 123, 2nd ser., no. 3, Aug. 1, 1961, p. 1021-1039.

Measurements of the **Reaction Rate Distribution** Produced by a Source of 14 MeV Neutrons at the Centre of a **Uranium Metal Pile.**– Measurements have been made of the 14 MeV flux, the total neutron leakage and the reaction rate distributions for $^{235}U(n,f)$, $^{238}U(n,f)$, $^{238}U(n,\gamma)$ and $^{239}Pu(n,f)$ in U piles of density 16.3 g/cm^3 and total weight up to 20 tons. – J. W. Weale, H. Goodfellow, M. H. McTaggart, and M. L. Mullender. *Reactor Science and Technology*, v. 14, nos. 2-3, May 1961, p. 91-99 + 1 plate.

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* Experimental Verification of the Space Charge Law ($I = k(e/m)^{\frac{1}{2}}V^{\frac{3}{2}}$) for Ion Beams From a **Plasma Ion Source.**– Application of the **space charge law** to ion beam formation using plasma ion sources as well as the results of previous experiments to verify this law are briefly discussed. – W. L. Rautenbach. *Nuclear Instruments and Methods*, v. 12, June 1961, p. 169-179.

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Theory of Order of Multicomponent Non-Stoichiometric **Solid Solutions** (Zeroth Approximation).– Exact definitions of the superlattice, and of sublattices of the multicomponent non-stoichiometric solid solutions, determine precisely the number l of sublattices into which the superlattice can be subdivided, calculate the configurational free energy in the zeroth approximation, for arbitrary solutions, conditions which the probabilities $p_{i\mu}$ of finding the atom of i-th kind of the μ-th sublattice have to satisfy. – Kazimierz F. Wojciechowski. *Physica*, v. 27, June 1961, p. 509-513.

Pre-Breakdown Ionization in Hydrogen at Low Pressures.– Detailed studies of pre-breakdown ionization in **hydrogen** gas at low pressures have been made in the presence of uniform electric fields and appropriate analytical methods and experimental procedures suitable for similar studies in crossed electric and magnetic fields have been established. – S. C. Haydon and A. G. Robertson. *Physical Society, Proceedings*, v. 78, pt. 1, July 1961, p. 92-102.

The Collective Treatment of a **Fermi Gas.** II.– The ground state energy of the free electron gas is calculated using the Rayleigh-Schrödinger variational method with the wave function $\Psi = D\Pi_i < _j f(x_{ij})$ where D is a determinant of plane waves and $f(x_{ij})$ a correlation function. – T. Gaskell. *Physical Society, Proceedings*, v. 77, pt. 6, June 1961, p. 1182-1192.

Radiation by **Charged Particles** Passing Through an **Electron Plasma** in an External **Magnetic Field.** – S. K. Majumdar. *Physical Society, Proceedings*, v. 77, pt. 6, June 1961, p. 1109-1120.

Magnetic Anisotropy in Single-Crystal Nickel Films.– **Single-crystal thin films of Ni,** in the thickness range 50-500 Å have been prepared, by epitaxial growth on rock-salt, and their magnetic anisotropy measured. – J. C. Anderson. *Physical Society, Proceedings*, v. 78, pt. 1, July 1961, p. 25-32.

Spin-Lattice Relaxation in Imperfect Cubic Crystals and in Non-Cubic Crystals.– An examination is made of the spin-lattice relaxation in the solid state of nuclei whose energy level spacings in a magnetic field are rendered unequal by quadrupole interactions with the crystalline electric field. – E. R. Andrew and D. P. Tunstall. *Physical Society, Proceedings*, v. 78, pt. 1, July 1961, p. 1-11.

Evaluation of **Molecular Integrals** by a Numerical Method.– Numerical integration in elliptical coordinates is proposed as a convenient method for the computation of most types of two-electron molecular integrals including some types of three- and four-center integrals, and in some cases, of one-electron two- and three-center integrals. – E. A. Magnusson and C. Zauli. *Physical Society, Proceedings*, v. 78, pt. 1, July 1961, p. 53-64.

Light-Scattering Properties of Pigment Suspensions. – The light-scattering properties of **pigment suspensions** are discussed in terms of an approximate theory, with special emphasis on the role of the size of the scattering particles and their refractive index relative to the surrounding matrix. – W. R. Blevin and W. J. Brown. *Optical Society of America, Journal*, v. 51, Sept. 1961, p. 975-982.

A System for **Microspectrophotometry** Employing a Commercial Recording Spectrophotometer. – Paul K. Brown. *Optical Society of America, Journal*, v. 51, Sept. 1961, p. 1000-1008.

Synthesis of Multiple **Antireflection Films** Over a Prescribed Frequency Band.– A brief review of network synthesis is given, leading up to the synthesis of quarter-wave transformers and multilayer films. Numerical tables are presented in this paper from which antireflection coatings of up to four layers can be designed by interpolation. – Leo Young. *Optical Society of America, Journal*, v. 51, Sept. 1961, p. 967-974.

* Dynamical Theory of **Electron Diffraction** for the Electron Microscopic Image of **Crystal Lattices.** I. Images of Single Crystals. II. Image of Superposed Crystals (Moiré Pattern).– The dynamical theory of electron diffraction is applied to the interpretation of electron microscopic images of lattice planes of plate- and wedge-shaped crystals. The wave functions and corresponding intensities predicting interference fringes on the exit surface of a crystal are derived. – H. Hashimoto, M. Mannami, and T. Naiki. *Royal Society of London, Philosophical Transactions*, v. 253, Ser. A. Mathematical and Physical Sciences, no. 1033, July 6, 1961, p. 459-516 + 5 figures.

Atomic Beam Resonance Experiments With Stored Beams.– The atomic-beam separated, oscillatory-field resonance technique has been used to study the hyperfine frequency of cesium which is perturbed by collisions with storage box walls. With a wall coating of long straight-chain saturated hydrocarbons, resonances are observed after as many as 200 wall collisions. – H. Mark Goldenberg, Daniel Kleppner, and Norman F. Ramsey. *Physical Review*, v. 123, 2nd ser., no. 2, July 15, 1961, p. 530-537.

Generalized **Koopman's Theorem.**– States that if the wave function of a many-electron system is approximately by a Slater determinant of **Hartree-Fock one-electron wave functions,** with one-electron energies defined as the difference in energy of $(N + 1)$- and N-particle systems, then these one-electron energies are given by the expectation value of the Hartree-Fock Hamiltonian with respect to the one-electron wave functions. – J. C. Phillips. *Physical Review*, v. 123, 2nd ser., no. 2, July 15, 1961, p. 420-424.

* Intensity Studies in **Raman Effect:** Effect of Temperature. I. Liquids. II. Associative Liquids and Molten Substances.– The influence of temperature on the intensities of Raman lines in some polar and nonpolar liquids and molten substances. – K. Venkateswarlu and K. Ramaswamy. *Zeitschrift für Physik*, v. 163, no. 4, June 1961, p. 457-466.

The General Theory of **Van der Waals Forces.**– Covers methods of **quantum field theory** in statistical physics, concerning molecular interaction forces between solid bodies, and a thin film on the surface of a solid body. – I. E. Dzyaloshinskii, E. M. Lifshitz, and L. P. Pitaevskii. *Advances in Physics*, v. 10, no. 38, Apr. 1961, p. 165-209.

PLASTICS

* The Effects of **High Vacuum** and **Ultraviolet Radiation** on Reinforced Plastics.– Tests were made on **glass fiber laminates** reinforced with polyester epoxy and phenolic resins and results

are reported here. – Norman E. Wahl. *SPE Journal*, v. 17, Aug. 1961, p. 759-761.

• **Chemical Plant Repairs** Using Epoxy and Polyester Resins.– The use of **epoxy** and **polyester resins** for the repair of chemical plant is described. The resins with additions of powdered fillers or reinforcing agents, e.g., glass cloth, have been used successfully for a wide variety of applications ranging from small repairs to pump casings to the renewal of 1500-cubic-meter tank bottoms. Resin repairs can be made quickly *in situ* by plant maintenance personnel, thus avoiding delays involved in movement of the affected plant to workshops and the use of specialist labor. Because the resins are cold-setting, repairs can be made in fire-risk areas where welding would involve special precautions. – H. Hughes and A. F. Hall. *Engineer*, v. 212, July 28, 1961, p. 137-141.

Our new format should help you scan the page quickly. Boldface clue words identify subject matter. Titles appear unchanged at the beginning of each abstract.

Gamma Irradiation of Fluorocarbon Polymers.– Several fluorocarbon polymers were irradiated with Co^{60} gamma radiation at doses up to 10^{22} ev/g. The polymers studied included **polytetrafluoroethylene, polytrifluoroethylene, polychlorotrifluoroethylene,** a copolymer of tetrafluoroethylene with **hexafluoropropylene,** and several rubbery vinylidene fluoride copolymers. **G-values** were measured for volatile products, for free radicals detected by electron spin resonance, and, in the case of polychlorotrifluoroethylene, for scissions. The course of degradation or crosslinking was followed by zero-strength-time and tensile-strength measurements. It was found that for polytetrafluoroethylene and its hexafluoropropylene copolymer the presence of air accelerated scission drastically. The mechanism of the radiation-induced changes is discussed in terms of free-radical intermediates. – Roland E. Florin and Leo A. Wall. *U. S. National Bureau of Standards, Journal of Research, Section A, Physics and Chemistry*, v. 65A, no. 4, July-Aug. 1961, p. 375-387.

• **MoS_2** Enhances Wear Resistance of **Nylon.**– Describes how controlled amounts of molybdenum disulfide, homogeneously dispersed in nylon, allow parts to be produced having superior **wear resistance** at competitive cost. – P. D. Mitchell. *Engineering Materials and Design*, v. 4, Aug. 1961, p. 502-506.

• Studies in IVth Group Organometallic Chemistry. VII. Synthesis of Some Hetero-Polymers Containing **Germanium, Tin,** and **Lead** in the Main Polymer Chain.– It has been shown that **di-p-styrenyl** derivatives of Ge, Sn, and Pb as well as **1,4-divinylbenzene** and **3,9-divinylspirobi(meta-dioxan)** react with diphenyltin dihydride to yield linear poly-addition polymers containing Sn or Sn and Ge or Pb in the main polymer chain. The polymeric products have been characterized by infrared spectroscopy, analytical data and molecular weight. – J. G. Noltes and G. J. M. Van der Kerk. *Recueil des Travaux Chimiques des Pays-Bas*, v. 80, July 1961, p. 623-631.

• Studies on the Polymerization of Methacrylic Esters. I. Polymerization of **n-Butyl Methacrylate** and Isobutyl Methacrylate. II. Polymerization of *n*-Butyl Methacrylate and **Isobutyl Methacrylate** in Benzene Solution. III. **Copolymerization** of *n*-Butyl Methacrylate and Isobutyl Methacrylate With **Vinyl Acetate** and **Acrylonitrile.** – A. S. Nair and M. S. Muthana. *Makromolekulare Chemie*, v. 47, nos. 2-3, July 1961, p. 114-142.

• **Copolymerization** Behavior of **N-Vinylcarbazole** and Other N-Vinyl Monomers. – R. Hart. *Makromolekulare Chemie*, v. 47, nos. 2-3, July 1961, p. 143-153.

Spinweld to Join Thermoplastic Parts.– Simple fixtures and standard drill-press equipment are all that are needed in this high-speed technique for assembling plastic materials. Production rates up to 60 welds per min are practical, but process is limited to **thermoplastic parts** with circular joint shapes. – R. L. Miller and D. M. Thompson. *Product Engineering*, v. 32, no. 35, Aug. 28, 1961, p. 20-22.

a • Polarized Infra-Red Studies on **Polyvinyl Chloride Films**– Effects of Drawing.– **Polarized infra-red spectra** were measured for the films of polyvinyl chloride with various degrees of syndiotacticity, and **effects of drawing** on dichroism and band shapes were studied. – M. Tasumi and T. Shimanouchi. *Spectrochimica Acta*, v. 17, no. 7, Aug. 1961, p. 731-754.

b • **Ethylene-Butene-2** Alternating Crystalline Copolymers.– Using many homogeneous or heterogeneous **catalysts,** able to polymerize ethylene through an anionic coördinated mechanism, linear-molecular weight copolymers of aliphatic olefin monomers with ethylene were prepared. The over-all **copolymerization** rate, and the composition or the copolymers obtained, depend on the type of catalysts employed. – G. Natta, et al. *American Chemical Society, Journal*, v. 83, Aug. 5, 1961, p. 3343-3344.

c • Effects of Structure on the Physical Properties of Macromolecular Substances.– Homogeneous, transparent or translucent solid materials either amorphously or partially crystalline were investigated, such as **epoxide resins, polystyrene, polyvinylchloride** and **polybutadiene.** The cause of the predominantly amorphous state of macromolecular bodies was given. The changes in the **structure-sensitive properties** in orientation and crystallization (heat conductivity, velocity of sound) were studied. (*In German.*) Der Einfluss der Struktur auf die physikalischen Eigenschaften makromolekularer Stoffe. – W. Holzmüller. *Plaste und Kautschuk*, v. 8, June 1961, p. 296-300.

d • **Ethylene-Propylene** Copolymerization in the Presence of Catalysts Prepared From Vanadium Triacetylacetonate.– Linear, high molecular weight, completely amorphous **copolymers,** having an ethylene molar content up to 80%, can also be obtained by catalysts prepared from halogen-free vanadium compounds and alkyl aluminum halides, keeping constant the ratio between the concentrations of the two monomers. The **catalyst** obtained from **$Al(C_2H_5)_2Cl$** and **vanadium triacetylacetonate,** when prepared and used at temperatures below 0 C., gives much higher copolymer yields than those observed operating at room temperature. The higher over-all polymerization rate at low temperatures is rather peculiar for this catalytic system and does not occur with catalysts prepared from vanadium chlorides and AlR_3. – Giulio Natta, Giorgio Mazzanti, Alberto Valvassori, Guido Sartori, and Diego Fiumani. *Journal of Polymer Science*, v. 51, June 1961, p. 411-427.

e • Isotactic *trans*-1,4 Polymers of 1,3-Pentadiene.– Isotactic *trans*-1,4-Polypentadiene may exist in two modifications: crystalline and paracrystalline (unidimensionally regular). The two modifications are characterized by different X-ray spectra and different densities. *trans*-1,4 **Isotactic polypentadienes** contain tertiary carbon atoms which are actually asymmetric. This permitted obtaining optically active polypentadienes by using **polymerization catalysts** prepared from optically active aluminum trialkyls. – G. Natta, L. Porri, P. Corradini, G. Zanini, and F. Ciampelli. *Journal of Polymer Science*, v. 51, June 1961, p. 463-474.

f • Fluorchemistry. V. **Polytetrafluorethylene.**– Comprehensive study of the **fabrication** of monomers and polymers, of the chemico-physical properties of this ethylene, its processing and use. Dispersions of the same compound and special fluorine plastics were investigated also. (*In German.*) Fluorchemie. V. Über Polytetrafluoräthylen. – H. Fischer. *Plaste und Kautschuk*, v. 8, June 1961, p. 304-310.

g • Degradation of Polyester Film by **Alcohols.**– Since the possibility of the use of methanol as a remedial measure in hermetic refrigeration units exists, various compounds were studied in order to determine their **reactivity with polyethylene terphthalate** film used in the new insulation system. The conclusion is that any of the ordinary antifreeze alcohols when added to the system would cause rapid **polyester degradation** in this new insulation system. – Claus J. Bushouse. *ASHRAE Journal*, v. 3, Sept. 1961, p. 61-64.

h • The **Polymerization of Styrene** by Sulphuric Acid. I. Theory of Fast-Initiated **Non-Stationary Polymerization.** II. The Kinetics of **Polymerization in 1:2-Dichloroethane.** III. The Molecular Weight Distribution. IV. **Chain-Stopping Agents** and Mechanisms. – I. R. E. Burton and D. C. Pepper. II. M. J. Hayes and D. C. Pepper. III. A. Albert and D. C. Pepper.

IV. D. H. Jenkinson and D. C. Pepper. *Royal Society, Proceedings*, v. 263, ser. A, Aug. 22, 1961, p. 58-88.

• **Electron Spin Resonance** Studies of **Polyvinyl Chloride** Irradiated in NH_3 Gas.— The radicals produced on **irradiation in NH_3** do not differ greatly from those obtained on irradiation in vacuum, but the reactivity of the former to SO_2 to form RSO_2 radicals is far higher than that of those obtained in vacuum. — Hisashi Ueda, Zen'ichiro Kuri, and Shoji Shida. *Journal of Applied Polymer Science*, v. 5, no. 16, July-Aug. 1961, p. 478-481.

Molecular Vibrations and **Structures** of **High Polymers.** I. General Method of Normal Coordinate Treatment by Internal Coordinates and **Infrared Frequencies** and Conformations of $(-CH_2-)_n$, $(-CH_2-O-)_n$, and $(-CH_2-O-CH_2-)_n$. — Tatsuo Miyazawa. *Journal of Chemical Physics*, v. 35, Aug. 1961, p. 693-713.

• **Radiation Crosslinking** of **Vinyl Chloride--Vinyl Stearate** Copolymer. — A. A. Miller. *Journal of Applied Polymer Science*, v. 5, no. 16, July-Aug. 1961, p. 388-396.

• The Development of **Crystallinity** and **Transparency** in **Irradiated Polyethylene.** — Boris Levy. *Journal of Applied Polymer Science*, v. 5, no. 16, July-Aug. 1961, p. 408-423.

• **Crystallinity** of Siloxane Polymers.— Four homopolymers (dimethyl-, phenylmethyl-, diphenyl-, and trifluoropropylmethylpolysiloxanes) and two copolymer systems (dimethylsiloxane-phenylmethylsiloxane and phenylmethylsiloxane-diphenylsiloxane) have been studied by observing **spherulite nucleation,** growth, and melting. A characteristic crystallization temperature is proposed which can be considered representative of the equilibrium freezing-melting point. This work isolates the crystallinity characteristics of pure **siloxane polymer** and **copolymer** systems. — David J. Fischer. *Journal of Applied Polymer Science*, v. 5, no. 16, July-Aug. 1961, p. 436-441.

Effect of Physical Treatments on the **Stability of Polyamides.** — Physical treatment by itself is not sufficient to heat stabilize **nylon** effectively. The deterioration of an unstabilized **piperazine copolymer** clearly demonstrates that the filaments are still susceptible to thermally induced oxidation, which occurs primarily in the amorphous regions. However, combining the proper physical treatment (quenching and drawing) with the proper additive results in a major improvement in stability. — M. M. Epstein and C. W. Hamilton. *Modern Plastics*, v. 38, no. 12, Aug. 1961, p. 113 + 6 pages.

• Permeation, Swelling and Diffusion in Polymers. I. Diffusion in **6-Nylon.**— Measures the **diffusion of water and Ni** in 6-nylon in a continuous and a noncontinuous process. The use of the Fick law to determine diffusion coefficients in order to establish the temperature and concentration relationship of diffusion is permissible in most cases. The continuous and the noncontinuous processes have different diffusion coefficients. (*In German.*) Permeation, Quellung und Diffusion in Polymeren. I. Diffusion in 6-Nylon. — F. H. Müller and E. Hellmuth. *Kolloid-Zeitschrift*, v. 177, no. 1, July 1961, p. 1-23.

• A Contribution to the Problem of the Measurement of the **Crystal Axis Orientation** in **Polycaprolactam Fibers** by the Radiographic Method.— The process is based on the use of rectangular X-ray diagram. Independent **X-ray diffraction pattern** investigations according to the diagonal angle and completed rectangular method were conducted for bristles of the material variously deformed. The suitability of the method is discussed. (*In German.*) Beitrag zur Frage Vermessung von Kristallitachsenorientierung an Polycaprolactamfasern auf röntgenographischem Wege. — G. W. Urbańczyk. *Kolloid-Zeitschrift*, v. 176, no. 2, June 1961, p. 128-131.

• Studies on the Nuclear Emulsions With Polyvinyl Alcohol. II. The Gamma-Ray Sensitivity of the **PVA Nuclear Emulsions.** — Silver bromide emulsion was prepared by using PVA as the protective colloid. The emulsion contained 70% of silver bromide by weight. The thickness of the emulsion layer was 45μ and its moisture content was 2.8% at a relative humidity of 60%. The emulsion can be used for **photographic dosimetry** of gamma-rays in the range of 10^2 to 7×10^3 roentgen. (*In Japanese.*) — Etsuo Fujii. *Government Chemical Industrial Research Institute, Tokyo, Reports*, v. 56, June 1961, p. 233-240.

POLLUTION AND WASTES

a • An Evaluation of the **Aerometric Probe.**— Discusses experimental use of a **radio-controlled drone** for meteorological and air quality observations. — Paul A. Humphrey. *Air Pollution Control Association, Journal*, v. 11, no. 8, Aug. 1961, p. 362 + 2 pages.

b • Valley Wind Phenomena and **Air Pollution Problems.**— The maximum wind speed associated with the **valley--plain wind** varies from valley to valley and from night to night in the same valleys. The average maximum wind speed is on the order of 7 to 12 mph. However, because of the sharp-nosed velocity profiles, the average wind speed at pollutant carrying levels may be anywhere from 2 to 12 mph depending on the effective height of the source, the height of the ridge line, and the strength of the prevailing flow. — Ben Davidson. *Air Pollution Control Association, Journal*, v. 11, no. 8, Aug. 1961, p. 364 + 5 pages.

c • Exhaust Gas Oxidation on **Vanadia-Alumina Catalysts.**— An approach is outlined for studying the kinetics of **exhaust gas oxidation,** using data on vanadia-alumina catalyst composition to illustrate the method. First order kinetics fit available data and the activation energy for the pure olefin oxidation by excess air is about 17 K cal, and that for CO is 21 K cal/mol. — W. B. Innes and R. Duffy. *Air Pollution Control Association, Journal*, v. 11, no. 8, Aug. 1961, p. 369-373.

d • **Wet Air Combustion.**— Presents a review of the theory of wet air combustion, the manner in which the equipment is arranged and operated, and reviews the pilot plant work which has been carried out using this method in the **waste disposal** field. — F. J. Zimmermann. *Industrial Water & Wastes*, v. 6, no. 4, July-Aug. 1961, p. 102-106.

e • **Industrial Odors.** I. The Olfactory Stimulus.— The adsorption **theory of olfaction,** the theory that smell is stimulated primarily by the absorption of odorant molecules on the olfactory epithelium, accounts satisfactorily for the most outstanding of the properties of smell. — R. W. Moncrieff. *Industrial Water & Wastes*, v. 6, no. 4, July-Aug. 1961, p. 107-110.

f • Rinsing Effectiveness in **Metal Finishing.**— At one dip and withdraw rate, a diffusion model qualitatively described the effect of contact time on flat plate rinsing effectiveness and quantitatively described the magnitude of **rinsing effectiveness.** — John A. Tallmadge, Jr. and Bryan A. Buffham. *Water Pollution Control Federation, Journal*, v. 33, Aug. 1961, p. 817-828.

g • Quantitative and Qualitative Shock Loading of **Activated Sludge Systems.**— In the main, the biochemical response to a **qualitative shock load** is the same as that for a **quantitative shock load,** after acclimation has been induced. The all-important difference is the rate or time factor involved. Whereas the waste under conditions of the quantitative shock load may be biologically purified during a normal detention time in the aerator, the qualitative shock load may not, and a large portion of waste will enter the receiving body. — A. F. Gaudy, Jr. and R. S. Engelbrecht. *Water Pollution Control Federation, Journal*, v. 33, Aug. 1961, p. 800-816.

h Chemical Analyses of **Automobile Exhaust Gases** for Oxygenates.— **Aldehydes** comprise about 80-90 mol.% of the total of the oxygenated groups, and **formaldehyde** accounts for about 50 mol.% of the total aldehydes. **Methyl ketones** constitute about 2 mol.% of the oxygenated compounds. The concentration of **oxides of N,** expressed as moles of NO_2 per million moles of water-free exhaust gas, is about 150, 1,600, and 2,800 at 15, 40, and 60 miles per hour, respectively. — C. F. Ellis. *U. S. Bureau of Mines Report of Investigations* 5822, 1961, 35 pp. (TN21 Un3r Vis.)

RELIABILITY ENGINEERING

k Meeting Today's Demands for **Product Reliability.**— Discusses the application of reliability programs in current industrial activity, and stresses that the reliability demanded can be met

only by close coordination between R & D, manufacturing, purchasing, quality control, and sales and service. – Dorian Shainin. *Management Review*, v. 50, Aug. 1961, p. 26-32.

Birth, Life, and Death in **Microelectronic Systems.**– Votetaker is proposed which compares the outputs of **paralleled (redundant) system parts** in a binary system and determines the most probable answer based on past performance of the separate parts. – B. Widrow, W. H. Pierce, and J. B. Angell. *IRE Transactions on Military Electronics*, v. MIL-5, no. 3, July 1961, p. 191-201. (TK1 In6.6mi Vis.)

Use of Passive **Redundancy** in Electronic Systems.– Discusses the application of redundancy techniques, of a nonadaptive and passive nature, to electronic circuits and systems. – J. J. Suran. *IRE Transactions on Military Electronics*, v. MIL-5, no. 3, July 1961, p. 202-208. (TK1 In6.6mi Vis.)

Electronic Equipment Reliability.– The **electronic reliability** problem; failure rates; faults; environmental conditions; construction techniques; circuits; testing; design; human engineering; prediction and calculation. – G. W. A. Dummer and N. Griffin. 274 pp. 1960. John Wiley & Sons, New York. (TK7870 D89e)

• The **Reliability** of an Experimental Transistorized **Data Handling System.**– Factors which influence reliability of large systems are considered. The construction of the equipment itself is briefly described. The commissioning and maintenance of the equipment and details of the docket-return system used to provide information about the reliability of the components used are discussed. A system of written logic, supplanting conventional drawings, facilitates maintenance. Component failure rates calculated from the fault recording system are given and observations made regarding the reliability achieved and considered possible. – V. J. McMullan and P. Cox. *British Institution of Radio Engineers, Journal*, v. 22, July 1961, p. 17-29.

• **Semiconductor Failure Analysis** Using Characteristic Curves. – The **characteristic curves** of a semiconductor device which has been found to be faulty can reveal important information about the nature of the failure. Breaks and erratic behavior in the forward and reverse characteristics can show whether the failure was due to surface contamination, voltage breakdown, mechanical stress or other causes. – Roy A. Holladay. *Electro-Technology*, v. 68, no. 2, Aug. 1961, p. 76-79.

RUBBER AND ELASTOMERS

• Studies on the γ-Irradiation of **Natural Rubber Latex.** The Effects of **Organic Halogen Compounds** on **Crosslinking** by **γ-Irradiation.**– 1,2-Dichloroethane, chloroform, carbon tetrachloride, and benzene were found to accelerate the reaction in proportion to their G values for radical formation. – Yuji Minoura and Mamoru Asao. *Journal of Applied Polymer Science*, v. 5, no. 16, July-Aug. 1961, p. 401-407.

• **Compounding Chlorobutyl** With Other Elastomers.– A study to provide new and improved **barriers in tubeless tires,** with considerable interest to those using chlorobutyl for other uses. – J. V. Fusco and R. H. Dudley. *Rubber World*, v. 144, no. 5, Aug. 1961, p. 67-72.

• Investigation of the Oxidation of **Polydimethylsiloxane Rubber.**– The **oxidation** of polydimethylsiloxane rubber has been investigated by determination of the elementary composition of volatiles liberated under experimental conditions, of maximum swelling and of the molecular weight of the soluble fraction. Splitting off of methyl groups during oxidation is evidently a chain process. The rate of the latter increases with increase in film thickness up to a given limit which depends upon temperature. A part of the H of the eliminated methyl groups remains bound with the polymer. The **elimination rate curve** of volatile organosilicon substances is S-shaped. The degree of structuring of the rubber is unilaterally determined by the number of eliminated methyl groups. In the initial oxidation period the ratio of the number of crosslinkages to the number of eliminated methyl groups is very low, but subsequently increases. (*In Russian.*) Issledovanie okisleniia polidimetilsiloksanovogo kauchuka. – A. S. Kuz'minskiĭ and E. A. Goldovskiĭ. *Vysokomolekuliarnye Soedineniia*, v. 3, no. 7, July 1961, p. 1054-1061.

• New **Synthetic Rubbers** From Crude Oil.– The stereospecific polymerization of isoprene yields *cis* **1,4 polyisoprene,** that is, the synthetic duplicate of natural rubber. Also *cis* **1,4 polybutadiene** is a very interesting elastomer in that it can substitute natural rubber either partially or completely. A new class of elastomers is formed by the ethylene-propylene copolymers, that show better properties in comparison with the most common synthetic rubbers used at present. Some properties of these new synthetic rubbers produced **from crude oil** are briefly described, and their possible applications are discussed. (*In Italian.*) Nuove gomme sintetiche dal petrolio. – Giovanni Crespi. *Chimica e l'Industria*, v. 43, July 1961, p. 769-774.

• Cast Polyurethane Rubber **Heart Valves.**– This report is based on a paper given by A. F. Finelli, R. H. Mayor, and R. M. Pierson, of Goodyear, to the Conference on Prosthetic Valves for Cardiac Surgery, sponsored by the Surgery Study Section, National Institute of Health, at Chicago, Ill., Sept. 9-10, 1960. The full paper appears in the book, "Prosthetic Valves for Cardiac Surgery," published by C. C. Thomas Co., Springfield, Ill. – *Rubber and Plastics Age*, v. 42, July 1961, p. 892-894.

• The **Strain** Dependence of Rubber **Viscoelasticity.** III. Natural and Butyl Rubber at High Extensions.– Dynamic Young's moduli are derived from observations of wave propagation in stretched filaments of **natural and butyl rubbers.** Extensions up to about 700% are studied within a temperature range of −45 to +50 C, and a frequency range of 0.2 to 20 kycles/sec. The effect is more pronounced for the natural rubber than for the butyl, and consequently the ratio of the friction coefficients (butyl: natural) falls from several hundred unstrained state to approximately 3 at 550% extension. – P. Mason. *Journal of Applied Polymer Science*, v. 5, no. 16, July-Aug. 1961, p. 428-435.

• The Mechanism of **Post Cure** of **Viton A** Fluorocarbon Elastomer.– The necessity for oven post-curing Viton A **vulcanizates** is explained in the following way: the formation of crosslinks is accompanied by the elimination of HF from the polymer. In the subsequent reaction of HF with the magnesium oxide present as acid acceptor water is formed which acts to inhibit the full development of cure unless it is removed from the vicinity of the polymer by post-curing in an open system. Measurement of the rate of elimination of water from the polymer serves as a method of folowing the development of crosslinking during cure. Approximatelv two moles of water, derived from four moles of hydrogen fluoride, are associated with the use of one mole of diamine curing agent. This ratio is confirmed by independent estimates of the relationship of crosslinking density to curing agent level based on measurements of swollen compression moduli. – J. F. Smith and G. T. Perkins. *Journal of Applied Polymer Science*, v. 5, no. 16, July-Aug. 1961, p. 460-467.

Mixing Equipment . . . for **Silicone Rubber Manufacture.**– **Dough mixers** and **rubber mills** are compared with regard to product quality, energy requirements, safety, and economics. – A. O. Liermann and D. E. Miller. *Industrial and Engineering Chemistry*, v. 53, Sept. 1961, p. 702-704.

• **Tread Wear Indexes** of Various **Synthetic Elastomers** Measured in Varying Severity Road Tests. – J. L. Ginn, R. L. Marlow, and R. F. Miller. *Rubber and Plastics Age*, v. 42, Aug. 1961, p. 968 + 3 pages.

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SOLID MECHANICS

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b • The Solid State **Parametric Amplifier.** — R. D. Weglein. *American Society of Naval Engineers, Journal*, v. 73, no. 3, Aug. 1961, p. 589-592.

• High Temperature **X-Ray Study** of the Thermal Expansion of **$InAs_3$ and $InSb_3$.** — Arne Kjekshus. *Acta Chemica Scandinavica*, v. 15, no. 3, 1961, p. 678-681.

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• **Organic Semiconductors.**— Report about conduction in **anthracene** crystals. — James J. Brophy. *Frontier*, v. 23, no. 1, Summer 1961, p. 4-9.

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a • **Electroluminescence** and Alpha-Numeric Indicators.– The basic properties of electroluminescence are first discussed and the paper then describes the construction of "organic-on-glass" and "ceramic-on-metal" lamps. Typical performance figures for these lamps as given. A description of the various types of **alpha-numeric indicators** that have been proposed follows. In particular, the "8-bar" digital indicator, and its variants, is compared with other types not requiring coding. Types of alphabet indicator are also discussed. – P. J. Clewer. *British Institution of Radio Engineers, Journal*, v. 22, July 1961, p. 69-73.

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SPACE HEATING AND CONDITIONING

° **Noise** Has Now Become a Major Problem.– Gives a résumé of research being done to **eliminate** or suppress **industrial** noise. – *Engineering*, v. 192, July 7, 1961, p. 6.

° **Air Conditioning.**– Discusses the importance and benefits of comfort and industrial air conditioning in the modern world and shows how the proper **design, installation,** maintenance and lubrication of air conditioning equipment has contributed significantly to the growing acceptance and use of this means of controlling man's indoor environment. – *Lubrication*, v. 47, July 1961, p. 73-84.

° **Refrigeration** Aspects of Air Conditioning.– It is essential that a close liaison exists between the **air conditioning** engineer and the refrigeration specialist concerned. In an endeavor to further promote this co-operation, notes concerning current refrigeration plant design practice and a number of problems which have to be considered when designing such a plant are presented. – B. W. Waters. *Institution of Heating and Ventilating Engineers*, v. 29, Aug. 1961, p. 180-189.

° Practical **Dust Control.**– A well-planned primary and secondary **ventilation program** fosters good dust control. – Frank J. Laird, Jr. *Mining Congress Journal*, v. 47, Aug. 1961, p. 54-57.

° An Engineer's Look at **Negative Air Ions.**– A summary of the latest data on effects of air ions of both polarities, on **health,** emotional well being and general alertness. – L. A. Staebler and F. P. Speicher. *Air Engineering*, v. 3, no. 8, Aug. 1961, p. 30-31.

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° The Control of **Noise.**– A collection of abstracts from papers presented at a conference on noise of bearings, gears, internal combustion engines, and its **effect on productivity.** – *Overseas Engineer*, v. 35, Sept. 1961, p. 44.

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° **Heating and Cooling of Air** Flowing Through an **Underground Tunnel.**– Equations and functions for computing the tempering effect are developed by mathematical analysis of the problem, assuming a sinusoidal variation of the outside air temperature, and are shown to be in substantial accordance with experimental results obtained in tests made in a small-scale model tunnel. – B. A. Peavy. *U. S. National Bureau of Standards, Journal of Research, Section C, Engineering and Instrumentation*, v. 65C, no. 3, July-Sept. 1961, p. 157-163.

° Comparative Measurements of the **Dust Content of** the **Air** by Deposition and Concentration Methods.– Comparative measurements have been carried out over a period of a year on the dust content of the air using two "Hibernia" and two

"Wabolu" funnels, two "Landesanstalt" apparatus, two 1 dm^3 and two ½ dm^2 adhesion foils and two concentration measuring apparatus. The method of evaluation is reported in detail; the limits of the methods of measurement are indicated by an exhaustive consideration of errors. (*In German.*) Vergleichsmessungen des Staubgehalts der Luft nach Niederschlagsund Konzentrationsmethoden. – Max Diem and Günther Jurksch. *Staub*, v. 21, Aug. 1961, p. 345-354.

° Investigations With the "Konitest" **Electrostatic Rust-Measuring Apparatus.** Effects of Temperature and Gas Flow.– Laboratory experiments are reported which have been carried out with the "Konitest" electrostatic dust-measuring apparatus. The function of the apparatus and the construction of the experimental installation are briefly discussed. The numerical values are given for the quantity flowing through as a function of the pressure difference. Further, the influence of the pressure difference on the electrical current from the excitation tube to earth is investigated. Finally, the relationship of this current to the temperature for four different excitation-tube/dust combinations was measured. (*In German.*) Untersuchungen am elektrostatischen Staubgehaltsmessgerät Konitest. Der Einfluss der Temperatur und des Gasdurchsatzes. – Wolfgang König and Hans Rock. *Staub*, v. 21, Aug. 1961, p. 355-357.

TEXTILES, FIBERS, LEATHER, AND PAPER

° The Theory of **Shrinkproofing of Wool.** II. Chemical Modification of the Fiber Surface and Its Effect on Felting Shrinkage, Friction, and Microscopic Appearance. – J. H. Bradbury. *Textile Research Journal*, v. 31, Aug. 1961, p. 735-743.

° **Wool** Fabric Stabilization by **Interfacial Polymerization.** I. Polyamides.– Fabric is padded consecutively through an aqueous solution of a diamine and a water-immiscible solution of a diacid chloride. Polymerization is extremely rapid and no heating or curing is required. Following the two-step padding, the fabric is simply washed and dried. Less than 5% resin on the fabric is required for **dimensional stability** in laundering. The wool fabrics treated are essentially unchanged in hand, flexural rigidity, break strength, percent elongation, and chemical resistance; they are improved in wrinkle recovery and smoothness after tumble drying. – R. E. Whitfield, L. A. Miller, and W. L. Wasley. *Textile Research Journal*, v. 31, Aug. 1961, p. 704-712.

° Flocculation of Streaming **Fibre Suspensions.** Influence of the Suspension Medium.– The flocculation of **papermaking pulps** was studied by measuring the variations of optical density of a laminar flow of 1 g/l suspensions in a transparent pipe. Water was used as a suspending medium, and various chemicals were added to the suspensions. The influence of the addition of small amounts of electrolyte was studied by using de-ionized water and de-ionized pulp. Addition of nonalkaline electrolytes resulted in an increase in the **flocculation** to a final constant value, which was independent of the particular electrolyte used Addition of alkaline electrolytes resulted in an initial decrease in flocculation followed by an increase to different constant values. – Olle Andersson and Jens-Jörgen Brunsvik. *Svensk Paperstidning*, v. 64, no. 13, July 15, 1961, p. 493-499.

° A New Form of **Collagen** Fibril. – Leo D. Kahn, Robert J. Carroll, and Lee P. Witnauer. *Biochimica et Biophysica Acta*, v. 50, no. 3, July 8, 1961, p. 592-593.

° The Effect of Slice Flow and **Flow** on the Wire on Newsprint **Paper Formation** and Properties II. – J. Mardon. *Paperi ja Puu*, v. 43, no. 6, June 1961, p. 383-396.

° Adhesion to **Fibrous Materials.**– Discusses nature of **adhesion,** rate of formation, and rate of setting. – J. J. Bikerman. *Tappi*, v. 44, Aug. 1961, p. 568-570.

° **Air Impingement Drying.** II.– Approximate method to calculate the evaporation when regard is given to the heating of the **paper,** whereby, it is possible to treat the process also for

faster running machines. – Claës Gustaf Allander. *Pulp and Paper Magazine of Canada*, v. 62, Aug. 1961, p. T392-T398.

• Fundamentals of **Drying Porous Materials.**– Discusses the application of the well-known laws of heat and mass transfer to drying, the influence of the nature of the solid on the falling-rate period, and the significance of two characteristic temperatures: the wet-bulb and the pseudo-wet-bulb temperatures. Considers the particular problem of drying sheet materials on heated cylinders. Relationships derived from the basic equations of heat transfer have been used to describe the temperatures and drying rates observed on a multicylinder machine applicable to **paper-making.** – A. H. Nissan and D. Hansen. *Tappi*, v. 44, Aug. 1961, p. 529-534.

• Status Report on **Bark Utilization.**– Examines results of commercial operations utilizing bark, identifies limitations in bark usage, and identifies future opportunities. – A. S. Gregory and D. F. Root. *Pulp and Paper Magazine of Canada*, v. 62, Aug. 1961, p. T385-T391.

• The Nature of the **Lignin—Carbohydrate Linkage** in Wood. Fractionation of Ball-Milled Wood Solubilized With Ethylene Oxide. – H. H. Brownell and K. L. West. *Pulp and Paper Magazine of Canada*, v. 62, Aug. 1961, p. T374-T384.

THERMAL MECHANICS

• Studies of Engine Combustion Processes by **Ionization Current.**– Ionization current flowing across the probe gap inserted in an engine **combustion chamber** is observed by means of an oscilloscope, and the effects on the current circuit and others are studied. – Kazuo Iinuma. *Bulletin of JSME*, v. 4, no. 14, May 1961, p. 352-357.

• Experimental Investigation of a Few Problems Arising in Once-Through **Forced-Circulation Steam Generators** Operating at Supercritical Pressures. – J. Kägi. *Sulzer Technical Review*, v. 43, no. 1, 1961, p. 29-35.

• Laminar Natural Convection Flow in **Magneto-Hydrodynamics.**– This paper deals with the two-dimensional **laminar natural convection flow** of an electrically conducting viscous fluid, such as **mercury** or **liquid sodium,** in the presence of electric or magnetic fields. – G. Poots. *International Journal of Heat and Mass Transfer*, v. 3, no. 1, Aug. 1961, p. 1-25.

• **Limits of Operation** of Chemical Reactors, Combustion Chambers, and Rocket Engines.– Correlations which have been used to define the operating limits of **gas turbines** and **ram jets** are compared with the theory of stirred reactors and the extension to **rocket chambers** is considered. – F. Fitzgerald and H. P. Hutchison. *Sheffield University, Fuel Society, Journal*, v. 12, 1961, p. 42-49.

An Experimental Study of Boiling in Reduced and Zero Gravity Fields.– A **pool boiling apparatus** was mounted on a counterweighted platform which could be dropped a distance of 9 ft. By varying the size of the counterweight, the effective gravity field on the equipment was adjusted between zero and unity. – C. M. Usiskin and R. Siegel. *ASME, Transactions, Series C, Journal of Heat Transfer*, v 83, no. 3, Aug. 1961, p. 243-253.

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Some Effects of Tensor Conductivity in **Magnetohydrodynamics.**– Concerns some **Hall-current effects** in inviscid, incompressible magnetohydrodynamics. The generalized Ohm's

law and the concept of tensor conductivity are discussed. The macroscopic equations governing steady small-perturbation flow of a fully ionized gas are developed for three orientations of an applied magnetic field of infinite extent. – B. Sonnerup. *Journal of the Aero/Space Sciences*, v. 28, Aug. 1961, p. 612 + 11 pages.

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• Fission, Fusion, and **Photonic Rockets.**– Discusses photonic fission and **water plasma** rockets. – Eugen Saenger. *Missiles & Space*, v. 7, May 1961, p. 18-21.

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Metallic Vapor Plasma: Future Propellant?– Describes experiments producing relatively large amounts of metallic vapor plasma by electrically exploding metallic wires and thin metallic films. High temperature expansion of the plasma has resulted in measurable thrust that may have future **propulsion** applications. – *Electronics*, v. 34, no. 33, Aug. 18, 1961, p. 20-21.

c

• Dynamic Behaviour of **Forced-Flow Evaporator Systems.**– Combined graphical and mathematical method is developed by which the transfer characteristics can be determined from the design data of the **steam generator.** This incidentally permits a clear picture to be gained of the complicated processes taking place in a heating system of this kind under transient conditions. – P. Profos. *Sulzer Technical Review*, v. 42, no. 4, 1960, p. 5-12.

d

• Calculation of the Dynamic Behaviour of **Heat Exchangers** With the Aid of **Analogue Computers.** – L. Acklin and F. Läubli. *Sulzer Technical Review*, v. 42, no. 4, 1960, p. 13-21.

Computers for **Steam Station Control.**– J. W. Skooglund and R. B. Squires. *Westinghouse Engineer*, v. 21, no. 5, Sept. 1961, p. 150-155.

e

The Neutralization of **Ion-Rocket Beams.**– The experimental ion-beam behavior obtained without neutralizers is compared with both simple collision theory and plasma-wave theory. Theories of **immersed-emitter and electron-trap neutralizer** operation are discussed; and, to the extent permitted by experimental data, the theory is compared with experimental results. – Harold R. Kaufman. *U. S. National Aeronautics and Space Administration, Technical Note, NASA-TN-D-1055*, Aug. 1961, 33 pp. (TL570 Un3t Room 290)

f

Ground and In-Flight Acoustic and Performance Characteristics of **Jet-Aircraft Exhaust Noise Suppressors.**– Characteristics were determined for a twin-engine jet aircraft with the following configurations: eight-lobe exhaust noise suppressors, eight-lobe nozzles and ejectors, and the unmodified aircraft. In-flight sound pressure levels measured on the ground under the flight path were reduced five to six decibels by the suppressors. Similar reductions in perceived noise level occurred. Increases in total **drag coefficient** of 3 and 7% and decreases in specific range of 5-14% were found to result from the suppressor configurations. – Willard D. Coles, John A. Mihalowe, and William H. Swann. *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-874*, Aug. 1961, 50 pp. (TL570 Un3t Room 290)

g

h

Plasma Engineering. III. **Applications of Plasma.**– Uses include thermonuclear fusion experiments, power conversion and **spacecraft propulsion.** Specific electronic applications are microwave traveling-wave amplifiers, backward-wave oscillators, uhf parametric amplifiers. Also: phase detectors, harmonic amplifiers, mixers and switches. – Michael F. Wolff. *Electronics*, v. 34, no. 35, Sept. 1, 1961, p. 29-35.

i

• **Electric Propulsion** Devices. An Analysis of Current Projects. – Descriptive analysis of **electric thrust** devices, **thermal arc jet** engines, **ion propulsion** engines, **cesium ion** engines, **heavy particle** engines and **electromagnetic propulsion** devices. – R. T. Craig. *Missiles & Space*, v. 7, Aug. 1961, p. 18-21.

j

• The Control of Sulzer Monotube **Steam Generator Plants** Operating at **Supercritical Pressures.** – M. Diethelm. *Sulzer Technical Review*, v. 42, no. 4, 1960, p. 23-29.

• Effect of Tube Spacing and Arrangement Upon the **Fouling Characteristics** of Banks of Tubes.– Results of model tests throwing light on this problem in **boilers.** – P. Profos and H. N. Sharan. *Sulzer Technical Review*, v. 42, no. 4, 1960, p. 31-43.

k

• New Shape in **Nozzle Seats.**— Advantages of a new "double-cone" injection nozzle seat for **diesel engines.** — *Equipment Superintendent*, v. 39, July 1961, p. 40.

WELDING AND JOINING

• **Electroslag Welding** of Heat Resisting **Perlitic Steel EI415.** — Describes a technique of automatic welding of steel EI415 of large sections, permitting high quality welds. The mechanical properties of the metal of the seam at room temperatures and above after heat treatment exceed the technical requirements. (*In Russian.*) Elektroshlakovaia svarka zharoprochnoĭ perlitnoĭ Stali EI415. — A. N. Safonnikov. *Avtomaticheskaia Svarka*, v. 14, no. 8(101), Aug. 1961, p. 65-69.

• Effects of Dynamic Properties of the Source of Current on **Welding in Carbon Dioxide** With a 2 mm Wire Diameter.— The speed of increase of the short-circuit current, influencing to a great extent the stability of welding and its technical characteristics, was determined for minimum spattering and a satisfactory forming of the seam. The resistance of SN welds to intercrystalline corrosion is increased after complete heat treatment, if the temperature of aging does not exceed 500 C. SN3 welds offer the best resistance to corrosion. (*In Russian.*) Vliianie dinamicheskikh svoĭstv istochnika toka na protsess svarki v uglekislom gaze provolokoĭ diametrom 2 mm. — I. I. Zaruba, A. G. Potap'evskiĭ, and V. F. Lapchinskiĭ. *Avtomaticheskaia Svarka*, v. 14, no. 8(101), Aug. 1961, p. 31-40.

Our new format should help you scan the page quickly. Boldface clue words identify subject matter. Titles appear unchanged at the beginning of each abstract.

• Influence of **Electrodes** Upon Shrinkage.— Investigations with different electrode diameters and thickness of coating; shape of butt welded specimens; measuring equipment; evaluation and comparison of the measured and calculated **shrinkage.** (*In German.*) Zum Elektrodeneinfluss auf die Schweissschrumpfung. — A. Matting and H. Wolf. *Schweissen und Schneiden*, v. 13, Aug. 1961, p. 315 + 4 pages.

• Methods of **Oxy-Acetylene Techniques.**— Multiplicity of oxy-acetylene methods of operation and their classification according to DIN 8522; welding and soldering methods; flame cutting, flame gouging, lance cutting; stress relieving and flame heating; and method of flame treating. (*In German.*) Verfahren der Autogen-Technik. — H. von Hofe and H. Killing. *Schweissen und Schneiden*, v. 13, Aug. 1961, p. 320 + 9 pages.

Review of Recent Developments in **Metals Joining.**— Discusses **plasma welding** of refractory metals, **explosive welding,** electroslag welding equipment, and **adhesive bonding.** — J. J. Vagi, W. J. Lepkowski, H. W. Mishler, and H. E. Pattee. *Battelle Memorial Institute, Defense Metals Information Center, DMIC Memorandum* 125, Sept. 1, 1961, 5 pp. (TN799 B32.2d Contin.)

• How to Control **Distortion** and Maintain Dimensional Stability.— Explains how proper design and welding procedures can control distortion and help maintain dimensional stability after the weldment is placed in service. — M. J. Shoelson. *Welding Design & Fabrication*, v. 34, Sept. 1961, p. 38-39.

• **All-Welded Plant** Makes 400 Tons of Steelmaking Oxygen a Day.— Welding played a key role in building and erecting a high-production **oxygen plant.** Discusses type of metals welded, specifications, and final testing of welds. — Herman F. Buschow. *Welding Design & Fabrication*, v. 34, Sept. 1961, p. 35-37.

The Evolution of Ductile High-Temperature **Brazing Alloys.** — **Silver brazing alloys** containing small amounts of Li, In, and Pd are now being used to bond stainless steel honeycomb. Alloys containing Au or Pd (or both) look promising for jet engine brazing applications. — D. C. Herrschaft. *Metal Progress*, v. 80, no. 3, Sept. 1961, p. 97-100.

Brazing of Components for Small Gas Turbine Engines.— Techniques and controls employed at Boeing in joining engine components made of **Rene 41** and other **high-temperature alloys.** — M. J. Stern. *Metal Progress*, v. 80, no. 3, Sept. 1961, p. 101 + 7 pages. a

• Designing a Weldable Alloy Using Metallurgical Parameters. — General aspects of developing alloys for weldability involves metallurgical and physical data. These parameters are applied to the design of **weldable Mo alloys.** — W. N. Platte. *Metal Progress*, v. 80, no. 3, Sept. 1961, p. 80-85. b

• **Pressure Welding by Rolling** at Elevated Temperatures.— The investigation of autogenous pressure welding by rolling, reported in previous papers, has been extended to examine the effects of increasing the temperature of welding for **Al, Armco Fe, Mg,** and **Zn.** — M. G. Nicholas and D. R. Milner. *British Welding Journal*, v. 8, Aug. 1961, p. 375-383. c

• The **Fatigue Strength** of **Butt Joints** in **H15 Alloy** Welded With **Cusil 73.** — W. O. Dinsdale and R. P. Newman. *British Welding Journal*, v. 8, Aug. 1961, p. 402-410.

Alloying During **Welding.**— Reviews those techniques which have proved practicable and dependable for welding processes such as manual **shielded-arc, submerged-arc, gas tungsten-arc,** and **gas metal-arc.** — George E. Linnert. *Metals Engineering Quarterly*, v. 1, no. 3, Aug. 1961, p. 39-56. d

• **Solid-Phase Bonding** of Columbium.— **Columbium** components to be bonded are enclosed in an evacuated envelope or welded to form a gas-tight assembly. The assembly is then subjected to an inert gas pressure and heated above the recrystallization temperature of Cb. The inert gas forces the components into the intimate contact necessary for diffusion to occur. Optimum bonding has been achieved at 1150 C with 10,000 psi of helium gas for a time of 3 hr. — S. J. Paprocki, E. S. Hodge, and P. J. Gripshover. Paper from "Columbium Metallurgy", v. X, p. 13-30, 1961. Interscience Publishers, New York. (TN799.N7 Sy68c) e

• The Metallurgy of **Weld Heat-Affected Zones** in **HY-80 High Strength Steel.** — G. N. Emmanuel, D. E. Young, and G. L. Spahr. *Metals Engineering Quarterly*, v. 1, no. 3, Aug. 1961, p. 82-97. f

The Connection of **Zircaloy-2** With Stainless Steel for Operation Over a Wide Temperature Range.— A method for joining Zircaloy-2 with **stainless steel,** using controlled expansion transition sections, is described. — C. Gordon Duff. *Nuclear Science and Engineering*, v. 10, July 1961, p. 278-284. g

• **Metal Bond** Between **Uranium** and **Aluminum** for Nuclear Reactor Fuel Elements.— A Zn/Sn soldering method is described. If cooling media are used, which is possible with Al surfaces at temperature above 230 C, a Ni diffusion bond is recommended. The properties and method of preparation of this metal bond were examined. Due to improvement of the diffusion-inhibiting layer, the bond was usable between 450 and 500 C. (*In German.*) Metallische Bindung zwischen Uran und Aluminium für Kernreaktor-Brennelemente. — G. Schneider. *Metall*, v. 15, July 1961, p. 675-679. h

• **Flux** and Filler-Wire Developments for **Submerged-Arc Welding HY-80 Steel.**— A new flux and **filler wire** were developed for submerged-arc welding submarine hulls. The flux raises weld metal impact properties while lowering O and inclusion contents; the new filler wire produces weld metal with notch toughness over 40 ft-lb at −80 F in both as-welded and stress-relieved states. — W. J. Lewis, G. E. Faulkner, and P. J. Rieppel. *Welding Journal*, v. 40, Aug. 1961, p. 337s-345s. i

• An **Automatic** Process for Welding Girth Joints in Steel **Pipelines.**— Describes process involving CO_2-shielded consumable-electrode **arc welding** used in a fixed horizontal position. The method is characterized by excellent weld quality, high welding speeds, and elimination of weld backing rings. — J. W. Nelson, G. E. Faulkner, P. J. Rieppel, and H .C. Cook. *Welding Journal*, v. 40, Aug. 1961, p. 813-820. j k

MISCELLANEOUS

The Decisions of Engineering Design.— Two examples of **plant design** are described and an abstract model of the process of design is suggested. The model is used to discuss the search for possible solutions, the strategies for their examination, and the rules for choosing between them. — David L. Marples. *IRE Transactions on Engineering Management*, v. EM-8, no. 2, June 1961, p. 55-71. (TK1 In6.6em Vis.)

Float-on-Air Travel. —Discusses the basic reasoning which stands behind the most controversial vehicle of the present day, **the air-rider.** Describes the way in which design thought has proliferated, branching in many directions from the original concept. From the **Hovercraft** to the Hoverbarrow, the potentialities of air-riders seem almost unlimited. — James Hay Stevens. *Aeronautics*, v. 44, no. 3, July 1961, p. 24-27.

* Building up **Periodic Motions.**— Indicates the conditions for the selection of the entrance signal of a system for the approximate formation of a given periodic process. The problem investigated refers to the **program control theory,** since it concerns the possibility of finding programming functions securing stable periodic program conditions. Permissible errors are evaluated. From a purely mathematical point of view, it is a question of formulating the conditions of conservation and stability of the periodic motion in the case of constantly active disturbances limited by the norm. (*In Russian.*) O postroenii periodicheskikh dvizhenīĭ. — E. A. Barbashin. *Prikladnaia Matematika i Mekhanika*, v. 25, no. 2, Mar.-Apr. 1961, p. 276-283.

On the Radicals of Certain Rings of Infinite Matrices.— Certain types of **rings of infinite matrices** are defined and some of their properties are discussed. The main theorems are concerned with the connections between the radical of a ring R and the radicals of rings of infinite matrices over R. — E. M. Patterson. *Royal Society of Edinburgh, Proceedings*, Sec. A, Mathematical and Physical Sciences, v. 65, pt. 3, 1959-60, p. 263-271. (Q41 R80.7p Vis.)

* The Rigidity of Closed Surfaces Nonhomeomorphic to a Sphere in **Riemannean Space.**— Considers the problem of the **rigidity of closed surfaces** with a positive external curvature nonhomeomorphic to a sphere. (*In Russian.*) Zhestkost ne gomeomorfnykh sfere zamknutykh poverkhnostei v pimanovom prostranstve. — A. V. Pogorelov. *Akademiia Nauk SSSR, Doklady*, v. 138, no. 1, May-June 1961, p. 51-52.

Radiation Damage in Solids.— Covers metals, alloys, covalent crystals, and ionic crystals; investigations of semiconductors; radiation effects in fissionable materials; radiation effects in graphite; theory of radiation damage; and the role of defects in the determination of the physical behavior of solids. — Douglas S. Billington and James H. Crawford, Jr. 450 pp. 1961. Princeton University Press, Princeton, N. J. (QC795 B49r)

On the Numerical Evaluation of a Class of **Multivariate Normal Integrals.**— The probability that each of n equally correlated normal random variables shall not fall short of a given value h is obtained as the product of the joint density function of the variables at the cut-off point $(h, h, \ldots, h)$ and an infinite power series in h. The coefficients in the latter series may be interpreted geometrically as the moments of a regular $(n\text{-}1)$-dimensional spherical simplex with common dihedral angles arc cos-ρ relative to a certain plane of symmetry. These moments may in their turn be expressed as linear functions of the measures of regular hyperspherical simplices of various dimensionalities, table of which are available elsewhere. — Harold Ruben. *Royal Society of Edinburgh, Proceedings*, Sec. A, Mathematical and Physical Sciences, v. 65, pt. 3, 1959-60, p. 272-281. (Q41 R80.7p Vis.)

* A Contribution to the Theory of **Optimum Regulation.**— The problem of optimum regulation can be resolved by a variation method with the help of Lagrange multipliers. The analogy between the equations of optimum regulation with the Lagrange equations in analytical mechanics is explained. Some special cases are considered. (*In Russian.*) K teorii optimal'nogo regulirovaniia. — Chzhan Sy-in. *Prikladnaia Matematika i Mekhanika*, v. 25, no. 3, 1961, p. 413-419.

Geometrical Approach to the **Theory of Probability.**— Presents an interesting **geometrical approach** to the derivation of some familiar equations in the theory of probability, and uses this newer approach for extending the scope of the equations. Particularly, extends the well-known problem of how many ways there are of distributing m identical objects among n numbered boxes with no more than one in each box to the problem of distributing the m objects in n boxes with no more than M in each box. The solution of this more general problem of M as the limiting number per box is expressed as a mathematical series involving factorials. — Dan McLachlan, Jr. and L. L. Chamberlain. *American Journal of Physics*, v. 29, no. 7, July 1961, p. 385-392.

* A Contribution to the Hill Method in the Theory of Linear **Differential Equations** With Periodic Coefficients. Determination of the Characteristic Coefficients.— An equation is developed which permits the determination of characteristic coefficients of any degree of accuracy. This equation is used in drawing a formula important in applications which, with accuracy of approximately the second order inclusively, makes it possible to determine the boundaries of the regions of parametric resonance of elastic systems. A simple criterion concerning the stability of the solution of the second order is given. (*In Russian.*) K metodu Khilla v teorii lineĭnykh differentsial'nykh uravneniĭ s periodicheskimi koeffitsientami. Opredelenie kharakteristicheskikh pokazateleĭ. — K. G. Valeev. *Prikladnaia Matematika i Mekhanika*, v. 25, no. 2, Mar.-Apr. 1961, p. 314-318.

* The Treatment of **Ventilation** Problems in the Knaben II Mine.— Discusses elimination of **silicosis** in **mining** operations in Norway. (*In Norwegian.*) Behandling av ventilasjonsproblemer i Knaben II grube. — C. Sandberg. *Tidsskrift for Kjemi, Bergvesen og Metallurgi*, v. 21, no. 4, Apr. 1961, p. 73-76.

* **Compressed Air and Gas Handbook.**— A reference book on all phases of industrial air and gas compressors and compressed-air-powered portable tools and rock drills used by industry. Among new topics added in this edition are materials-handling systems, air circuitry and controls, air gaging, specialty tools, automation components, and process gas compressors. 3rd Ed. Sections individually paged. 1961. Compressed Air and Gas Institute, New York. (TJ985 C73c3 Ref.)

* Partial Correlations in **Regression Computations.**— The partial correlation between the dependent variable and the k-th independent variable in a regression can be calculated simply from the k-th regression coefficient and its standard error. Partial correlations are useful in determining relations among the estimates obtained under alternative assumptions about which variables in a regression are independent of the disturbances. — Robert L. Gustafson. *American Statistical Association, Journal*, v. 56, no. 294, June 1961, p. 363-367.

* **Off-the-Road Locomotion.**— Deals with some of the material presented at the First International Conference on the Mechanics of Soil Vehicle Systems held in Turin and Saint Vincent, Italy, from June 12 to 16, 1961. — R. M. Ogorkiewicz. *Engineer*, v. 212, July 7, 1961, p. 4-6.

A Graphical Method for Evaluation of **Statistical Detection Equation.**— **Detection probability theory** is used to obtain practical design criteria for **radar digital detection systems.** A generalized set of detection curves, based on the work of the author and others, is presented, and a graphical method of applying these curves to the design of single-channel detection systems is illustrated. — Paul F. Marino. *GT & E Research & Development Journal*, v. 1, no. 2, July 1961, p. 77-86.

Laws of **Physical Laws.**— Statements about scientific laws, called metanomological statements, are examined. The following kinds are distinguished and illustrated: factual metanomological statements like "Newton's laws of motion are invariant under time reversal"; normative **metanomological statements** such as "The equations of motion are not to depend on any frame of reference"; and **methodological metanomological** statements like "Law statements should not include egocentric particulars such as 'now'." — Mario Bunge. *American Journal of Physics*, v. 29, no. 8, Aug. 1961, p. 518-529.

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Basic Radio Propagation Predictions

FOR AUGUST 1961

Three Months in Advance

Issued May 1961

CRPL Series D Number 201

The Central Radio Propagation Laboratory

The propagation of radio waves over long distances depends on their reflection from the ionosphere, the electrically conducting layers in the earth's upper atmosphere. The characteristics of these layers are continually changing. For regular and reliable communication, it is therefore necessary to collect and analyze ionospheric data from stations all over the world in order that predictions of usable frequencies between any two places at any hour can be made. During the war, the United States Joint Communications Board set up the Interservice Radio Propagation Laboratory at the National Bureau of Standards to centralize ionospheric work and predictions for the Armed Forces of the United States.

On May 1, 1946, this activity returned to peacetime status as the Central Radio Propagation Laboratory of the National Bureau of Standards. Designed to act as a permanent centralizing agency for propagation predictions and studies, analogous in the field of radio to the reports of the Weather Bureau in the field of meteorology, the Central Radio Propagation Laboratory was established in cooperation with the many government agencies vitally concerned with communication and radio propagation problems. These agencies are represented on an Interdepartmental Council on Radio Propagation and Standards which assists in furthering the work of the Laboratory; included are the Departments of State, Army, Navy, and Air Force, United States Information Agency, United States Coast Guard, Civil Aeronautics Administration, and Federal Communications Commission. Observers have been designated by the Air Navigation Development Board, Interdepartment Radio Advisory Committee, United States Coast and Geodetic Survey, and United States Weather Bureau. The Council works in cooperation with a Technical Advisory Committee appointed by the Institute of Radio Engineers at the request of the Director, National Bureau of Standards.

The Central Radio Propagation Laboratory receives and analyzes data from approximately 120 stations located throughout the world, including 8 domestic and 17 overseas stations which are operated either directly or under contract by the National Bureau of Standards. Ionospheric data and predictions are disseminated to the Armed Forces, commercial users, scientists, and laboratories. The basic ionospheric research of the Laboratory includes theoretical and experimental studies of maximum usable frequencies, ionospheric absorption, long-time variations of radio propagation characteristics, the effects of the sun on radio propagation, and the relation between radio disturbance and geomagnetic variation. In the microwave field, the Laboratory is investigating the relation between radio propagation and weather phenomena, as well as methods by which predictions can be made and radio communications improved in this portion of the radiofrequency spectrum. Another phase of the Laboratory's work is the development and maintenance of standards and methods of measurement of many basic electrical quantities throughout the entire frequency spectrum.

Basic Radio Propagation Predictions

The CRPL Series D, Basic Radio Propagation Predictions, is issued monthly as an aid in the determination of the best sky-wave frequencies over any path at any time of day for average conditions for the month of prediction, 3 months in advance. Charts of extraordinary-wave critical frequency for the $F2$ layer, of maximum usable frequency for a transmission distance of 4,000 km, and of percentage of time occurrence for transmission by sporadic E in excess of 15 Mc, for a distance of 2,000 km, are included.

Beginning with the January 1959 issue (CRPL-D173) the CRPL-D series, "Basic Radio Propagation Predictions," is available on a purchase basis from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., on the following terms:

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MAY 1961
CRPL Series D
NUMBER 201

BASIC RADIO PROPAGATION PREDICTIONS

FOR AUGUST 1961 THREE MONTHS IN ADVANCE

Introduction

The CRPL-D series, "Basic Radio Propagation Predictions," issued by the National Bureau of Standards, contains contour charts of monthly median $F2$-zero-MUF and $F2$-4000-MUF for each of four zones, W, I (Afro-European), E, I (Pacific), (figs. 1 to 8); a worldwide contour chart of monthly median E-2000-MUF (fig. 9); a contour chart of median fEs (fig. 10); and a chart showing percentage of time occurrence for Es-2000-MUF in excess of 15 Mc (fig. 11). Local time used for North Pole: 75°W; for South Pole: 105°E.

Methods for using these charts are given in Circular 465 of the National Bureau of Standards, entitled "Instructions for the Use of Basic Radio Propagation Predictions," and available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., price 30 cents (to foreign countries, 40 cents). Procedures described in this manual should be modified to take into account the separate contour charts for the two I zones. Zone boundaries are the same as shown in figure 1 of Circular 465.

Requests for the manual of instructions and for the basic predictions from members of the Navy or Air Force should be sent to the proper service address as follows. For the Navy: The Director, Naval Communications. For the Air Force: Directorate Telecommunications, Department of the Air Force, Washington 25, D. C., Attention: AFOAC–FC.

Following figure 11 of each issue, sets of auxiliary figures (nos. 1, 2, 11, 12 of NBS Circular 465) or forms CRPL-AF and AH are given in rotation, two in each issue of CRPL Series D. They are necessary or useful for the preparation of tables and graphs of MUF and FOT (OWF), as explained in NBS Circular 465.

The charts in this issue were constructed from data through February 1961, together with the smoothed 12-month running-average Zürich sunspot number 75, centered on August 1961. The mean number for the year 1960 was 112.

Information concerning the theory of radio-wave propagation, measurement technics, structure of the ionosphere, ionospheric variations, prediction methods, absorption, field intensity, radio noise, lowest required radiated power, and lowest useful high frequency is given in Circular 462 of the National Bureau of Standards, "Ionospheric Radio Propagation." This circular is available from the Superintendent of Documents, price $1.25 (to foreign countries, $1.65). Additional information about radio noise may be found in NBS Circular 557, "Worldwide and Radio Noise Levels Expected in the Frequency Band 10 Kilocycles to 100 Megacycles," also available from the Superintendent of Documents, price 30 cents (to foreign countries, 40 cents) and in C.C.I.R. Report No. 65, "Revision of Atmospheric Radio Noise Data," International Telecommunciation Union, Geneva, 1957.

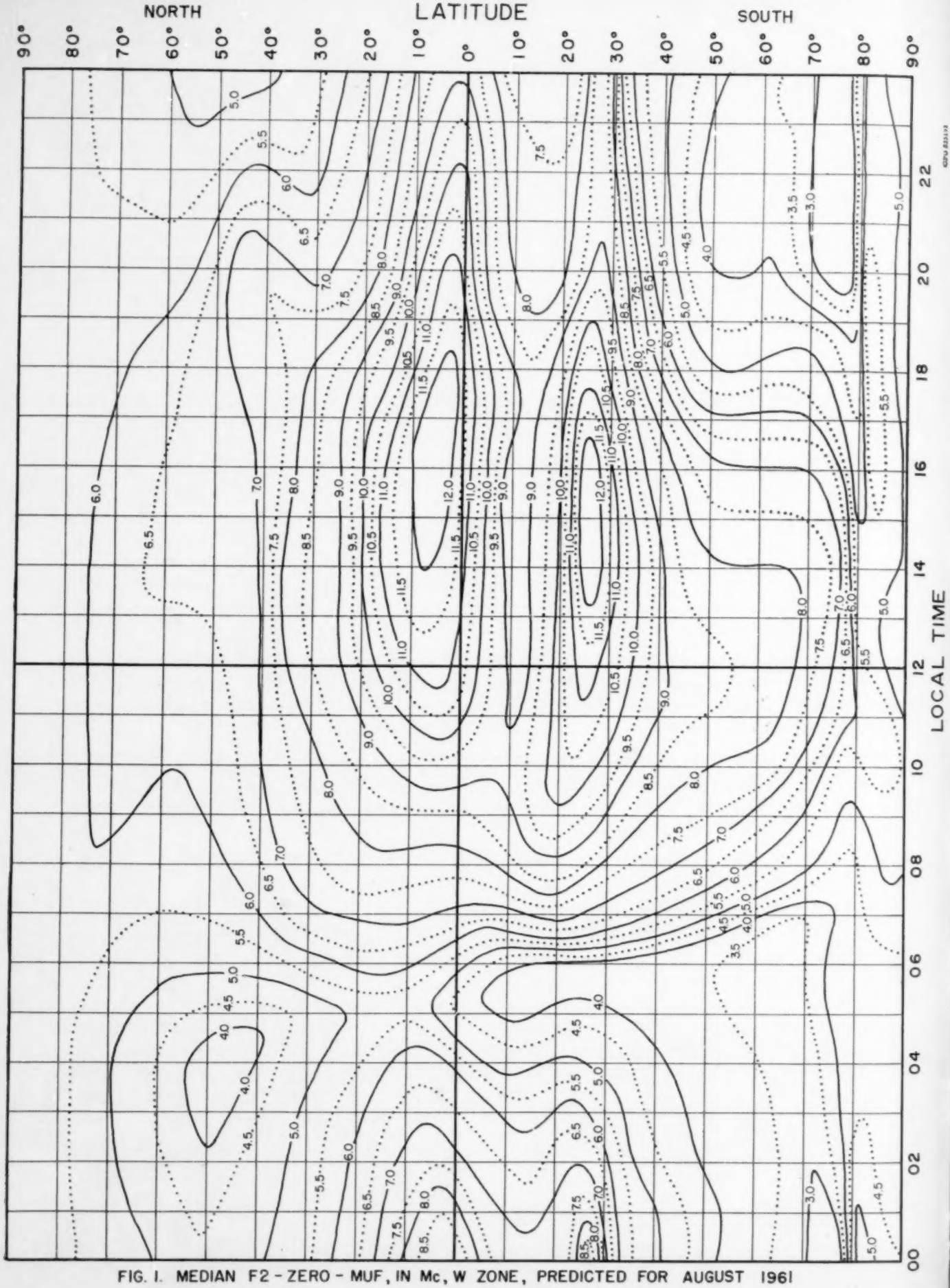


FIG. 1. MEDIAN F2 - ZERO - MUF, IN Mc, W ZONE, PREDICTED FOR AUGUST 1961

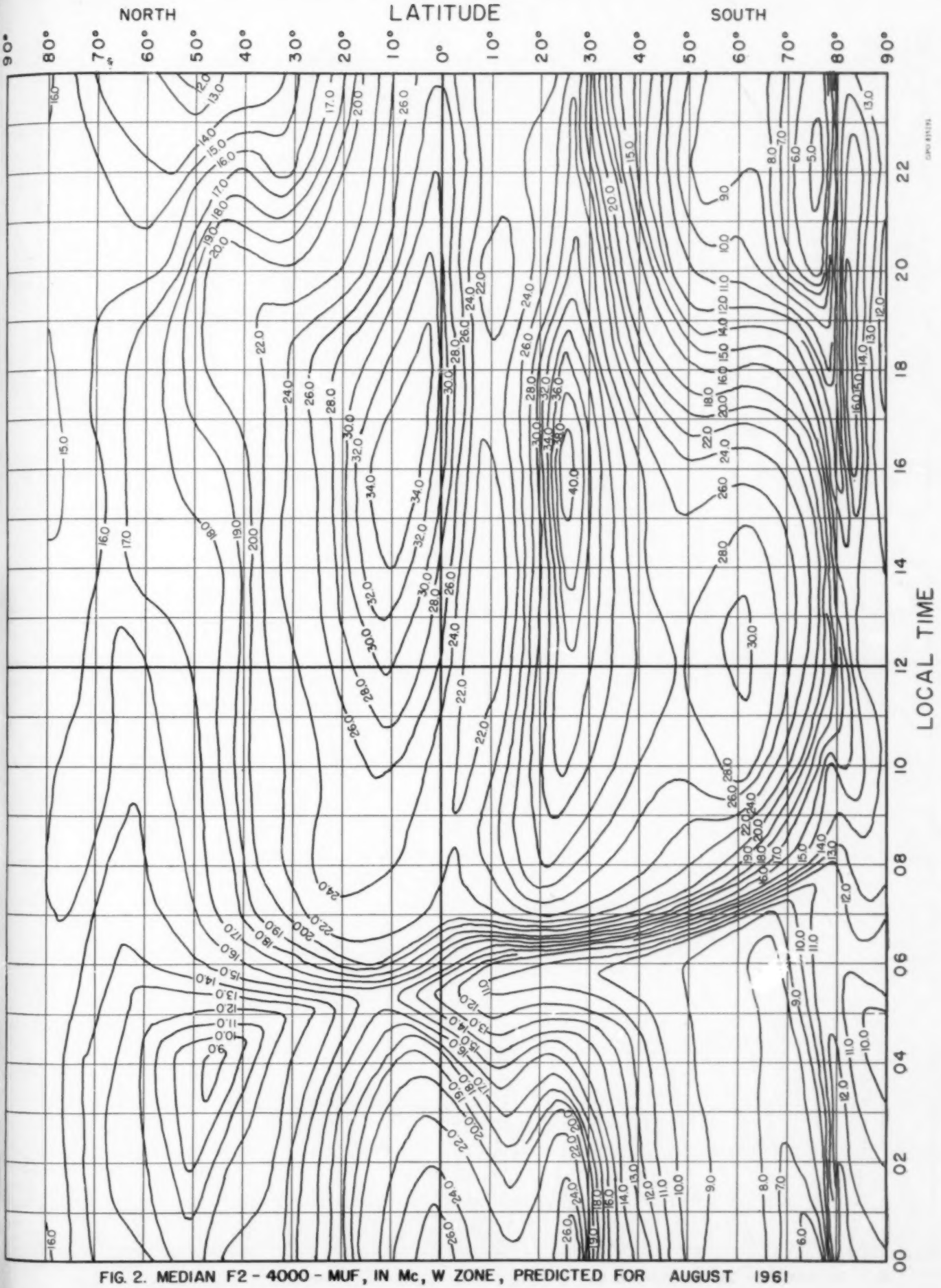


FIG. 2. MEDIAN F2 - 4000 - MUF, IN Mc, W ZONE, PREDICTED FOR AUGUST 1961

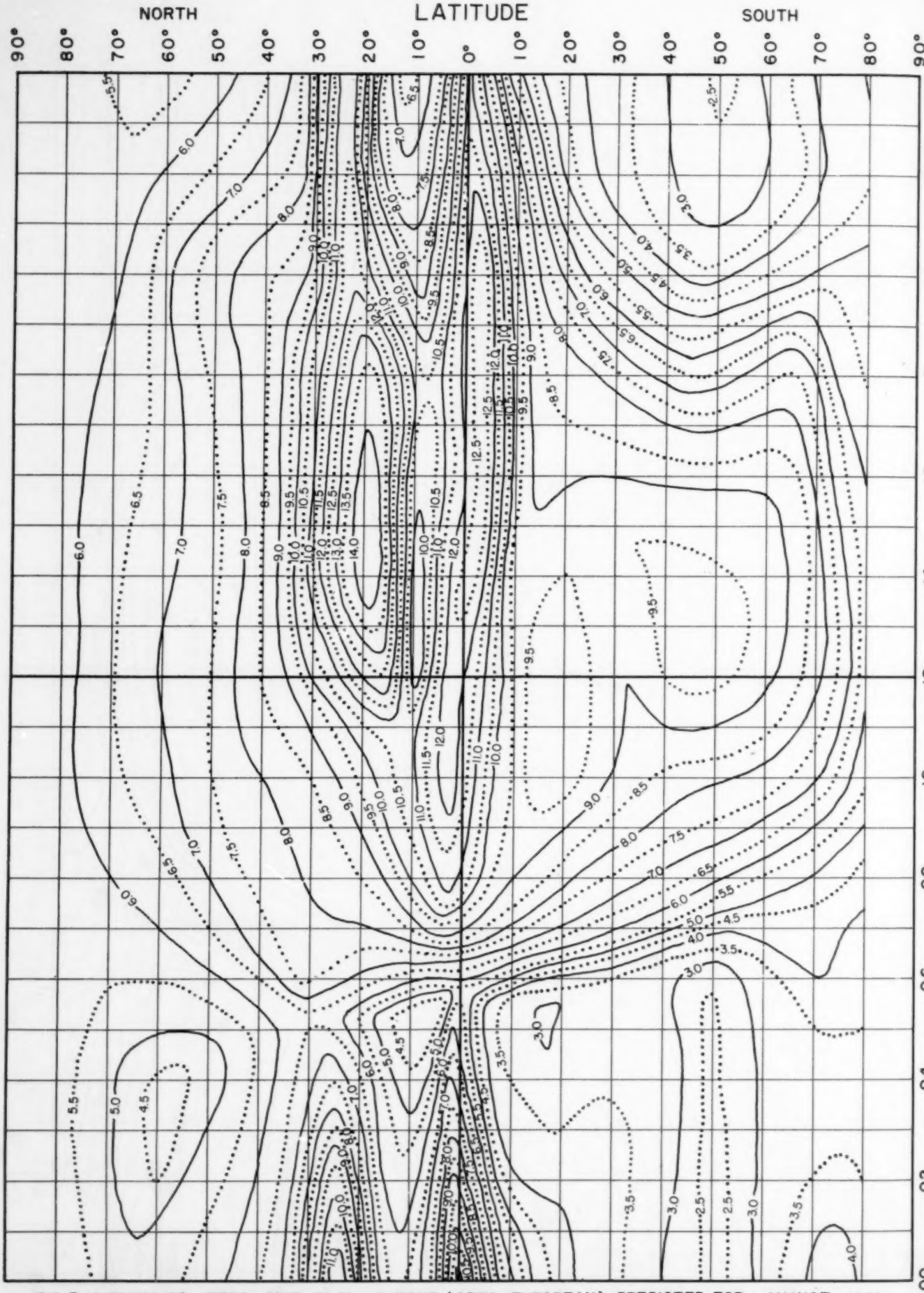


FIG. 3. MEDIAN F2 - ZERO - MUF, IN Mc, I ZONE (AFRO - EUROPEAN), PREDICTED FOR AUGUST 1961

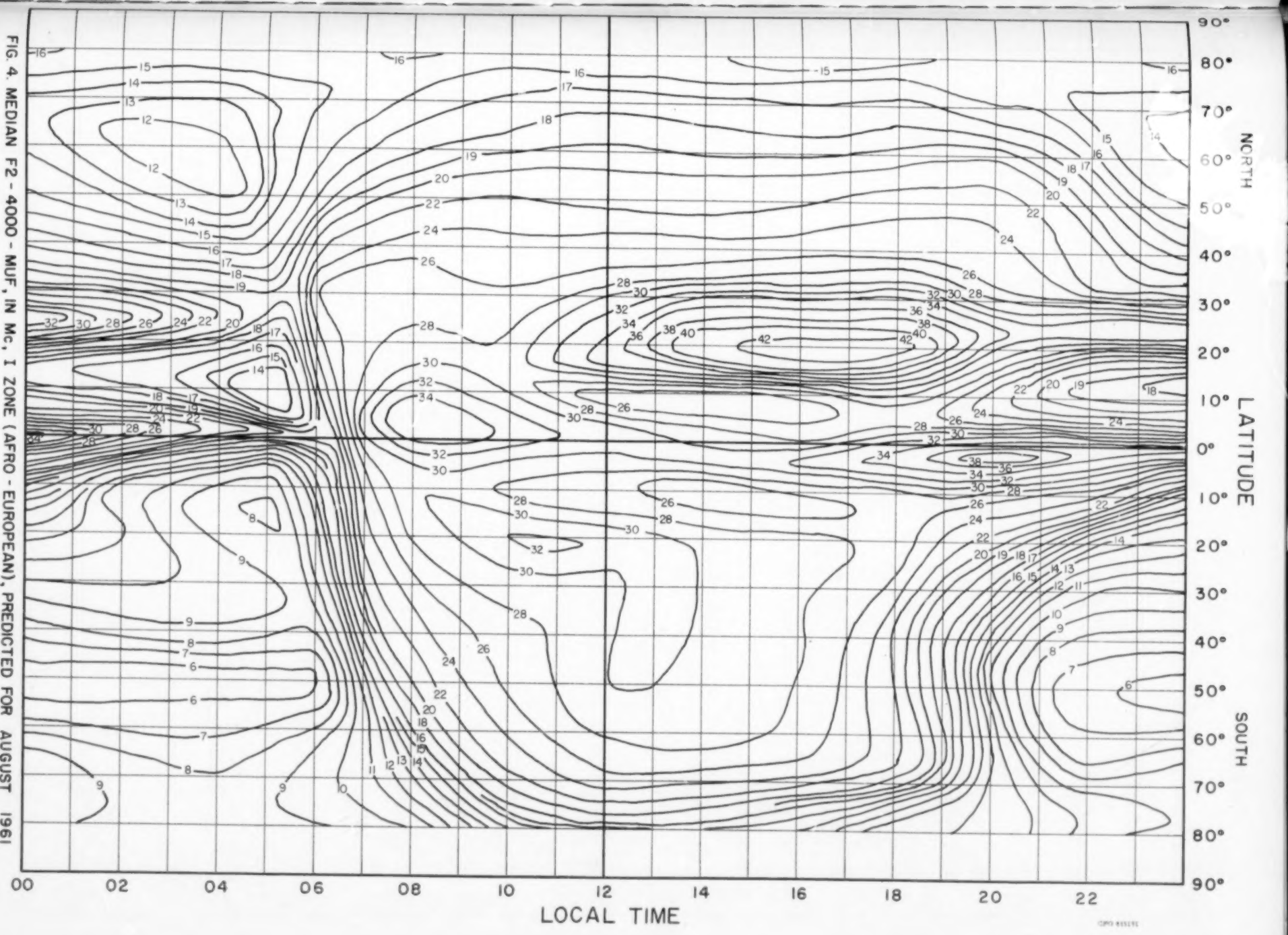


FIG. 4. MEDIAN F2 - 4000 - MUF, IN Mc, I ZONE (AFRO - EUROPEAN), PREDICTED FOR AUGUST 1961

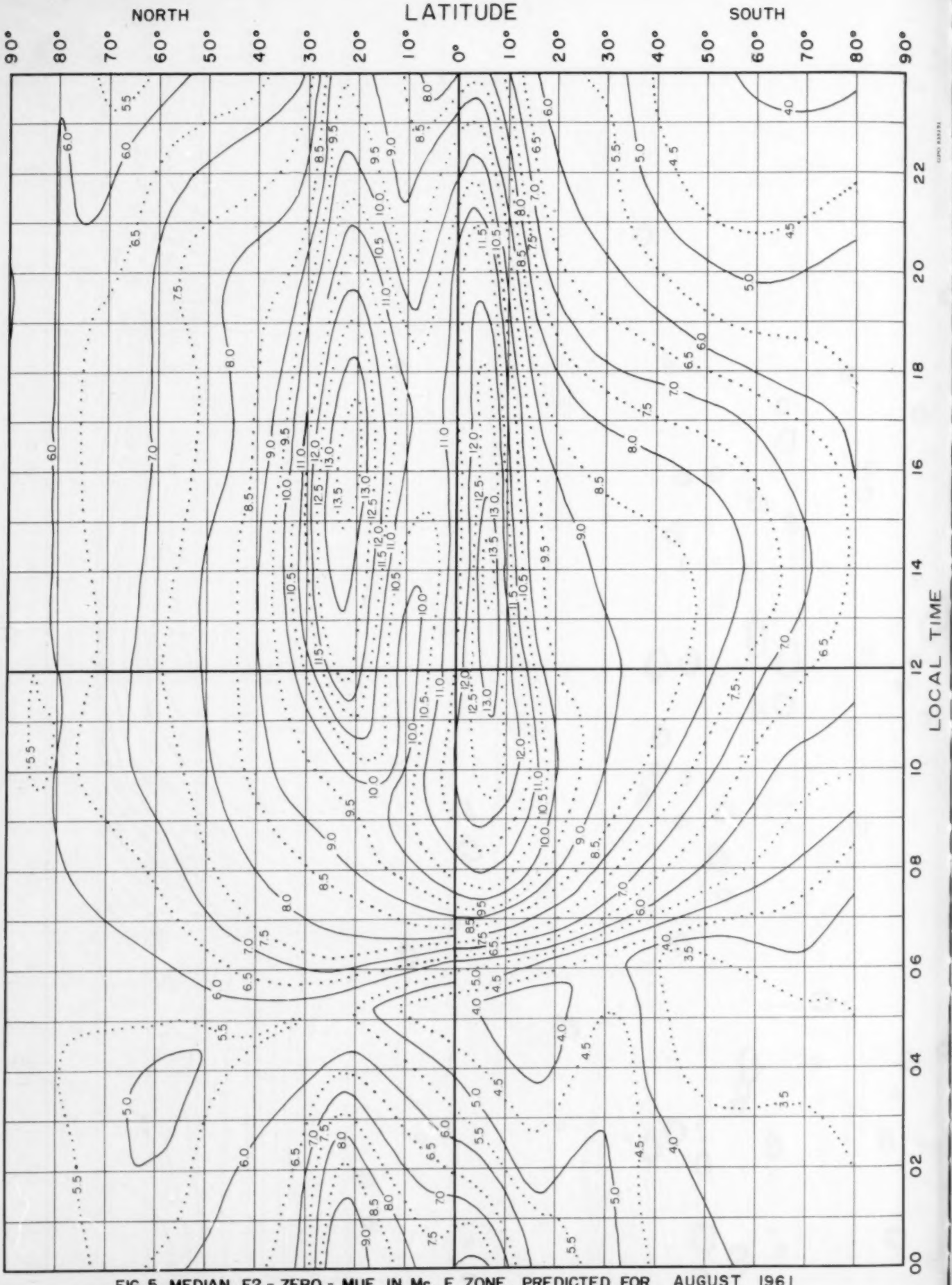


FIG. 5. MEDIAN F2 - ZERO - MUF, IN Mc, E ZONE, PREDICTED FOR AUGUST 1961

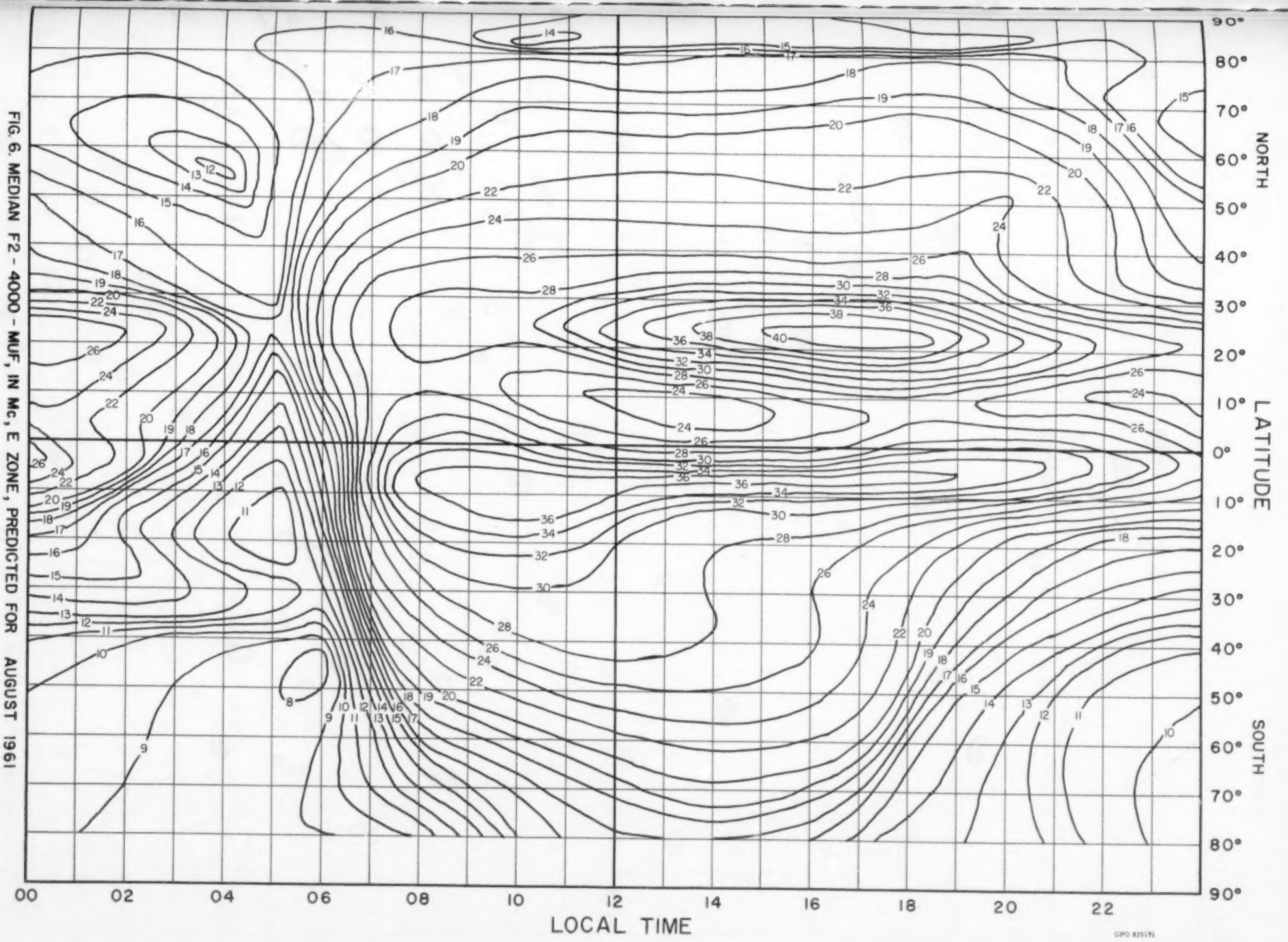


FIG. 6. MEDIAN F2 - 4000 - MUF, IN Mc, E ZONE, PREDICTED FOR AUGUST 1961

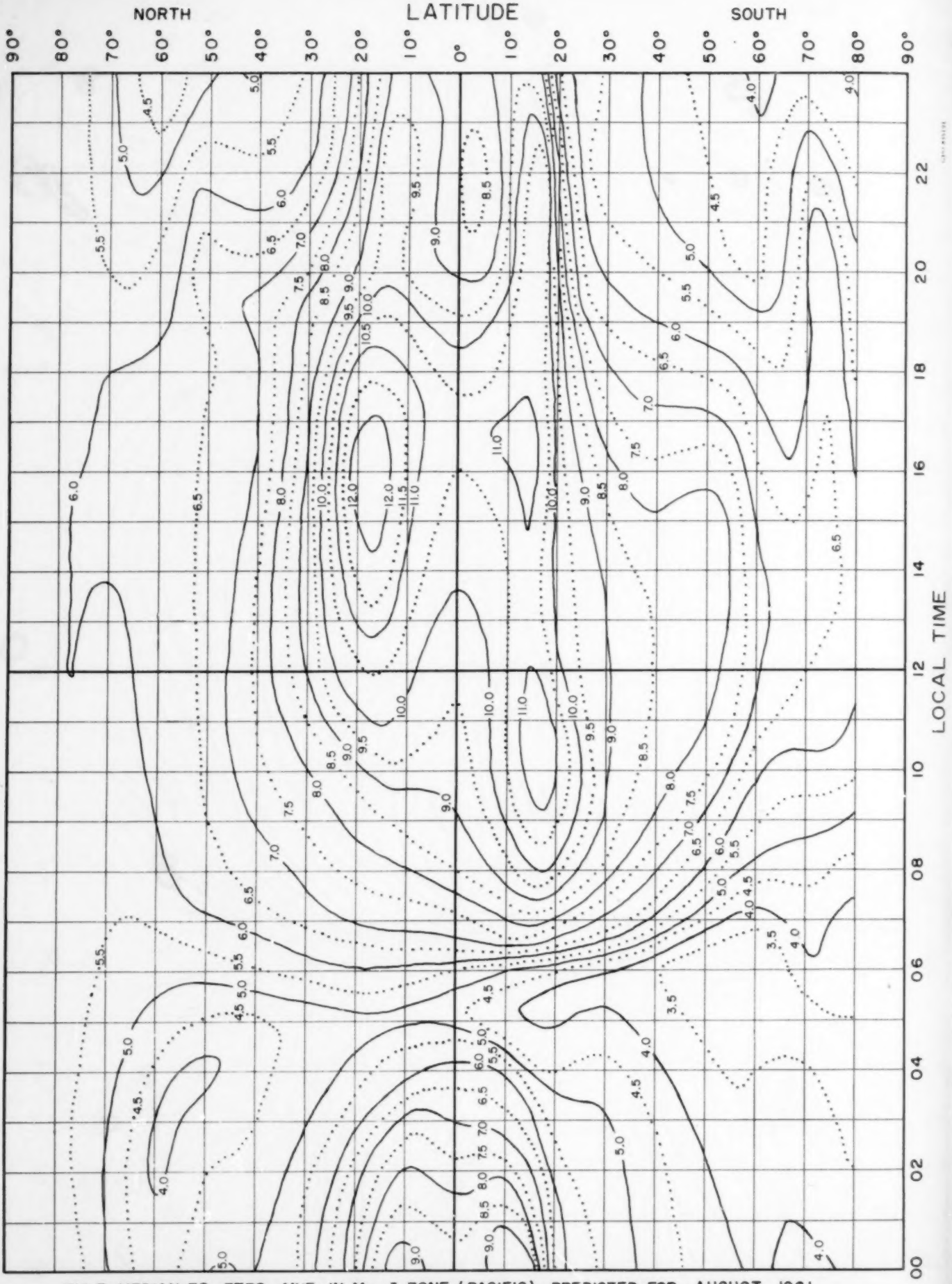


FIG. 7. MEDIAN F2 - ZERO - MUF, IN Mc, I ZONE (PACIFIC), PREDICTED FOR AUGUST 1961

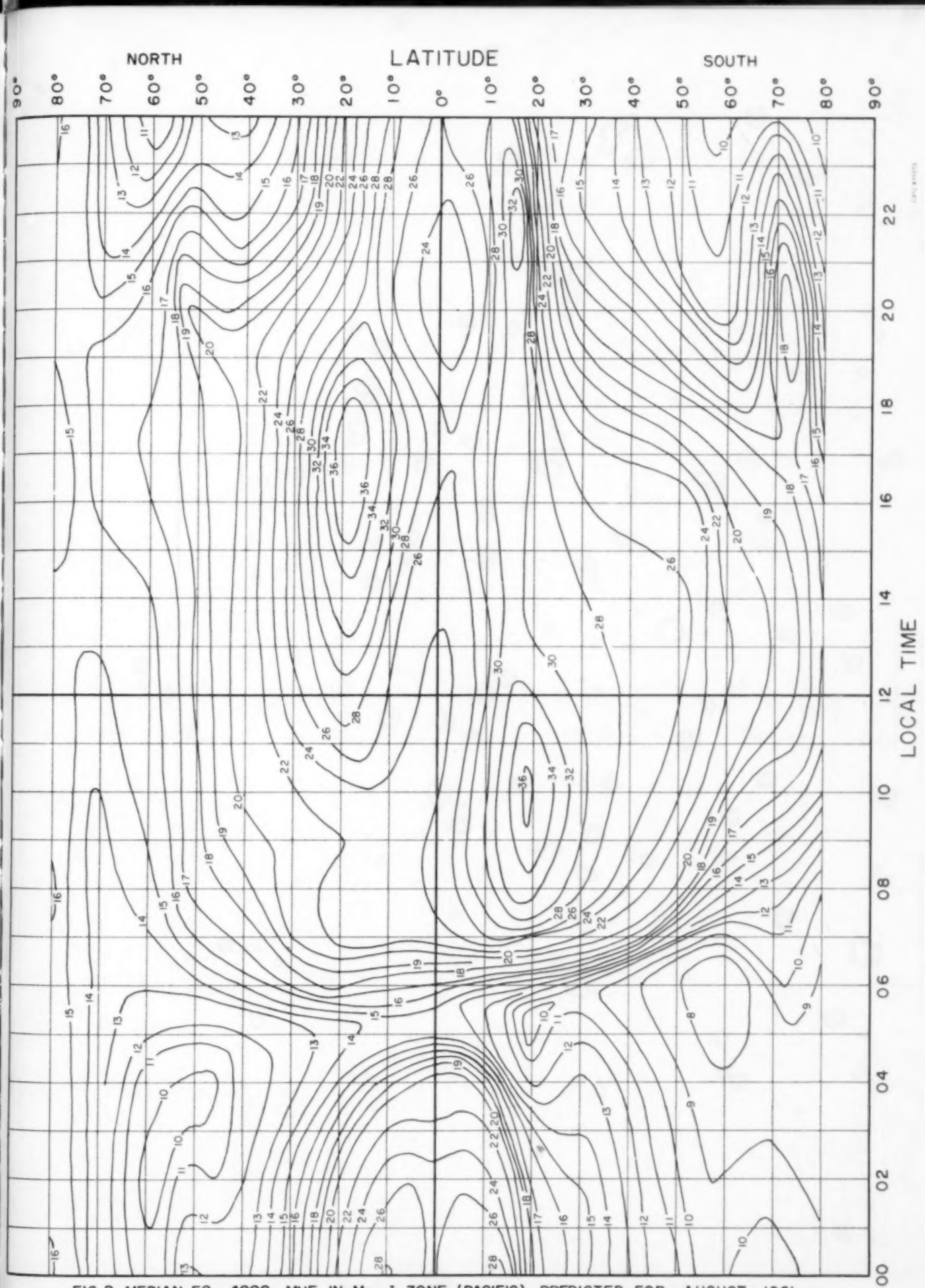


FIG. 8. MEDIAN F2 - 4000 - MUF, IN Mc, I ZONE (PACIFIC), PREDICTED FOR AUGUST 1961

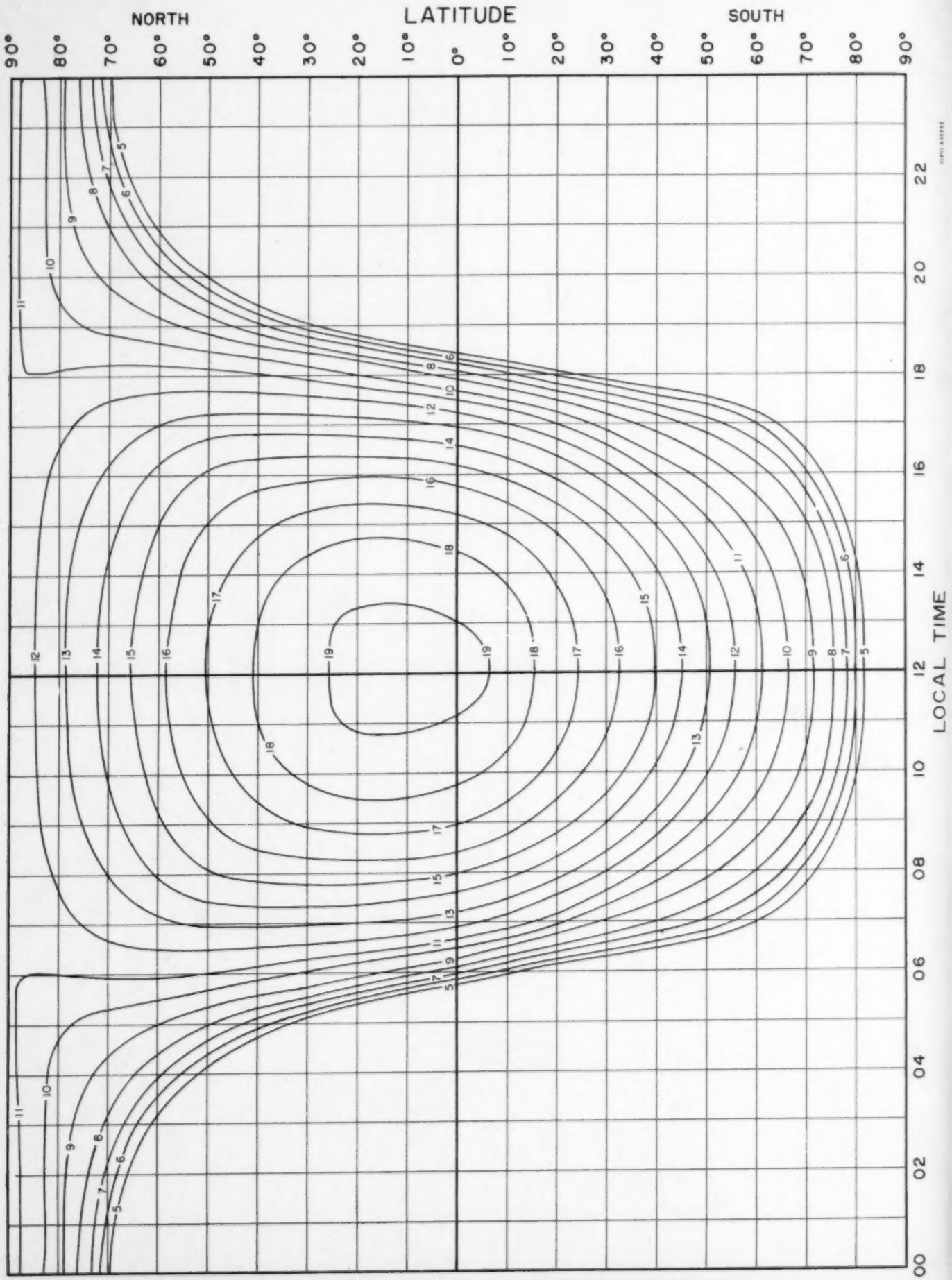


FIG. 9. MEDIAN E - 2000 - MUF, IN Mc, PREDICTED FOR AUGUST 1961

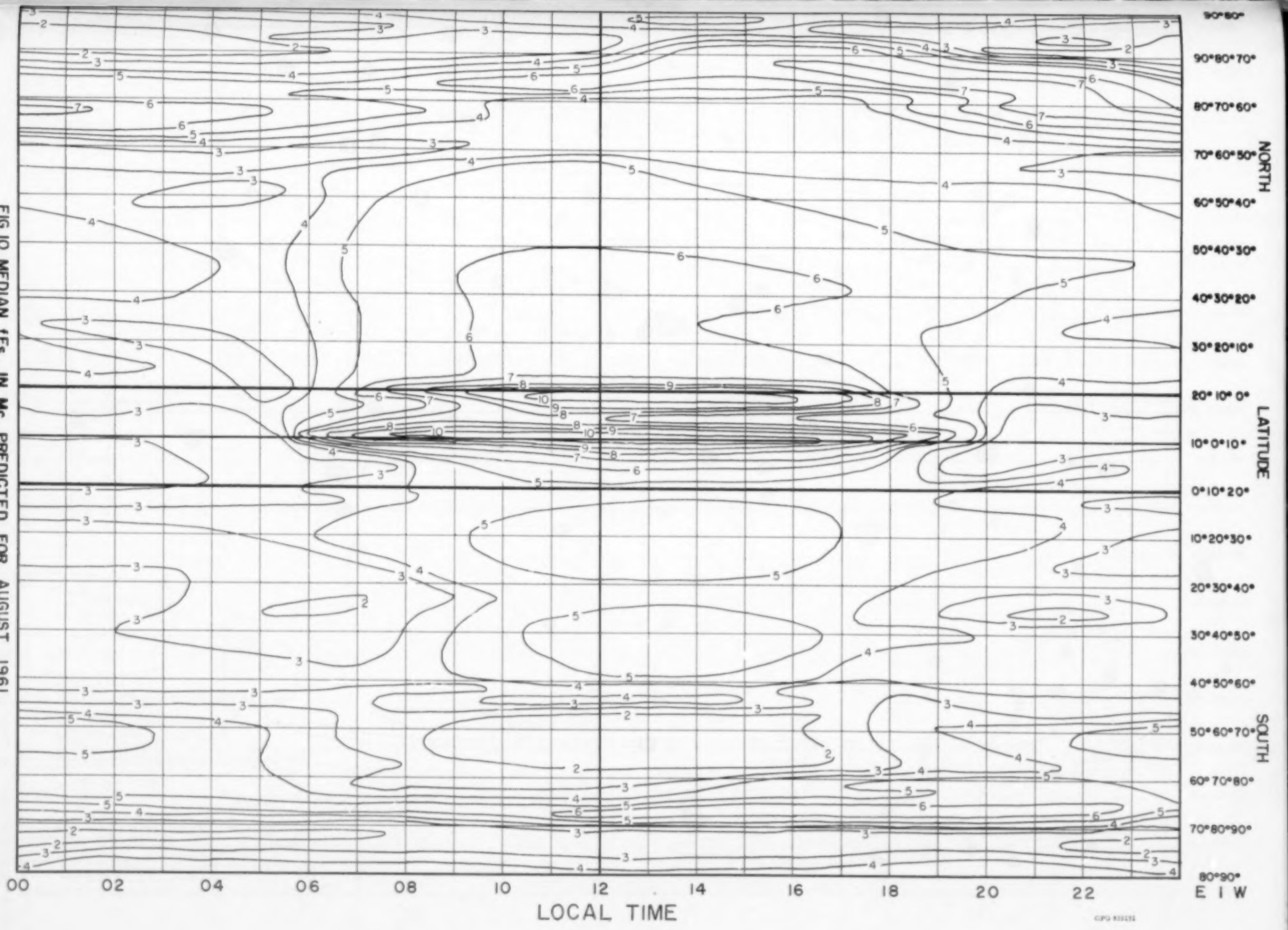


FIG. 10 MEDIAN fEs, IN Mc, PREDICTED FOR AUGUST 1961

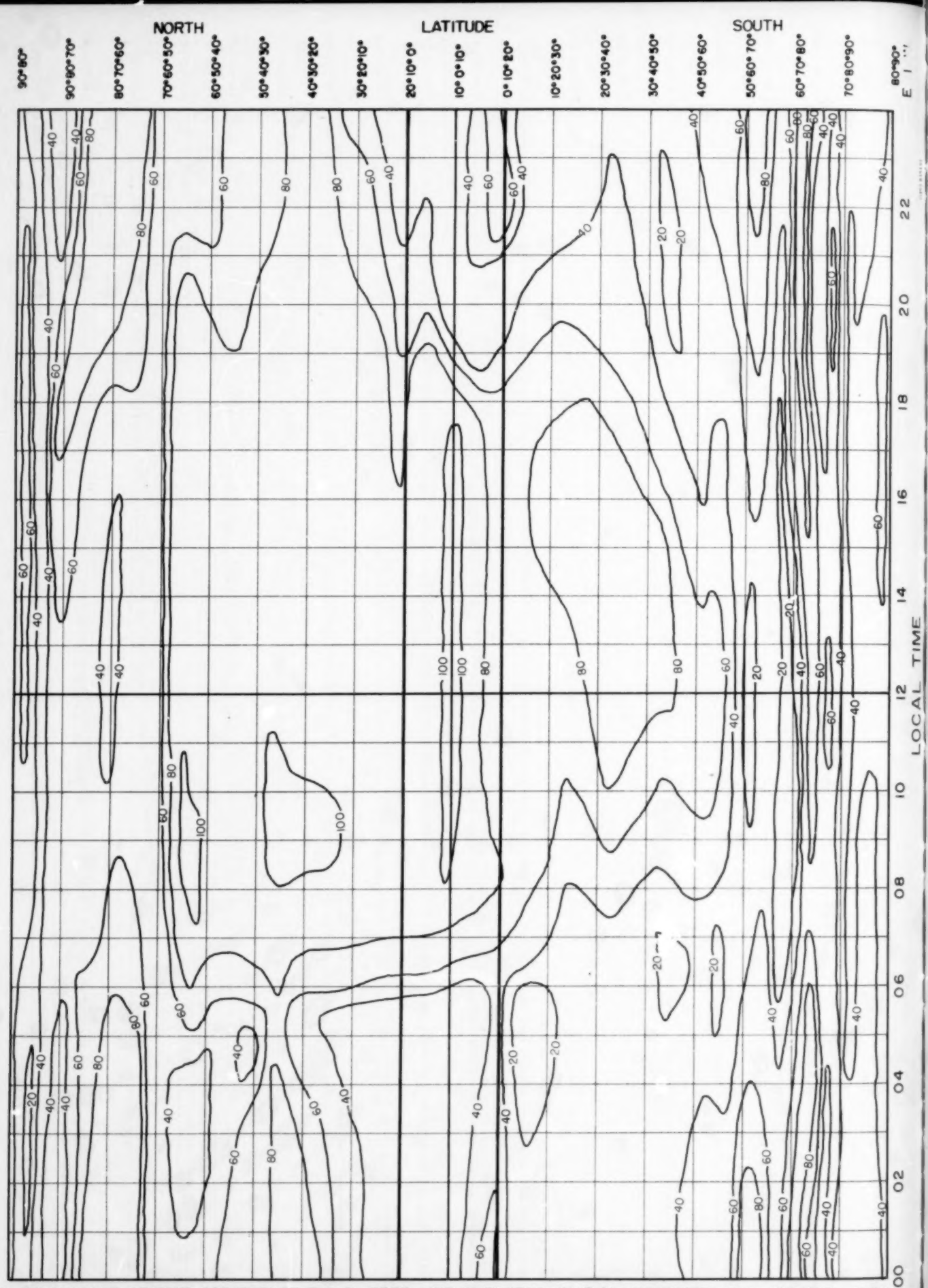
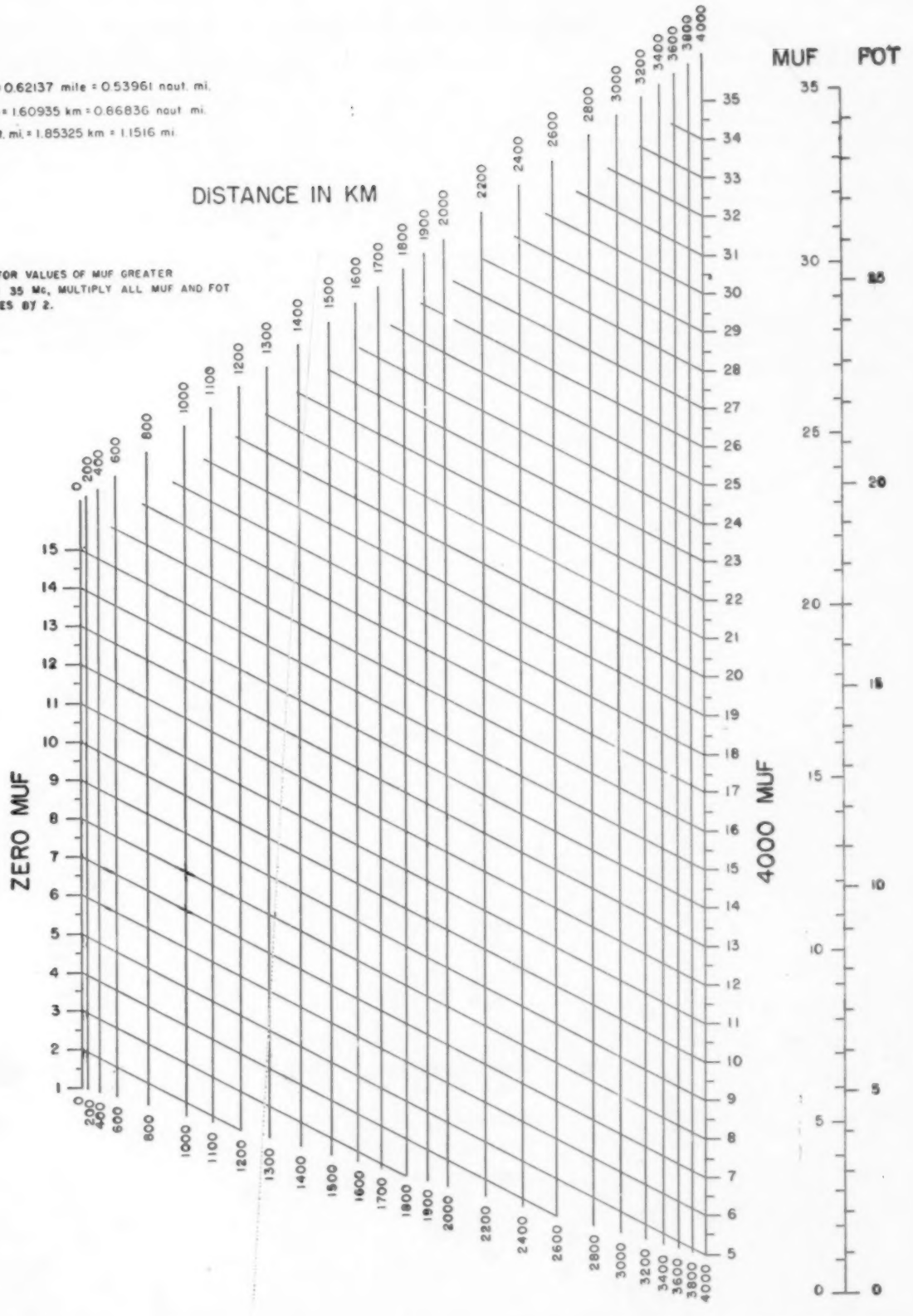
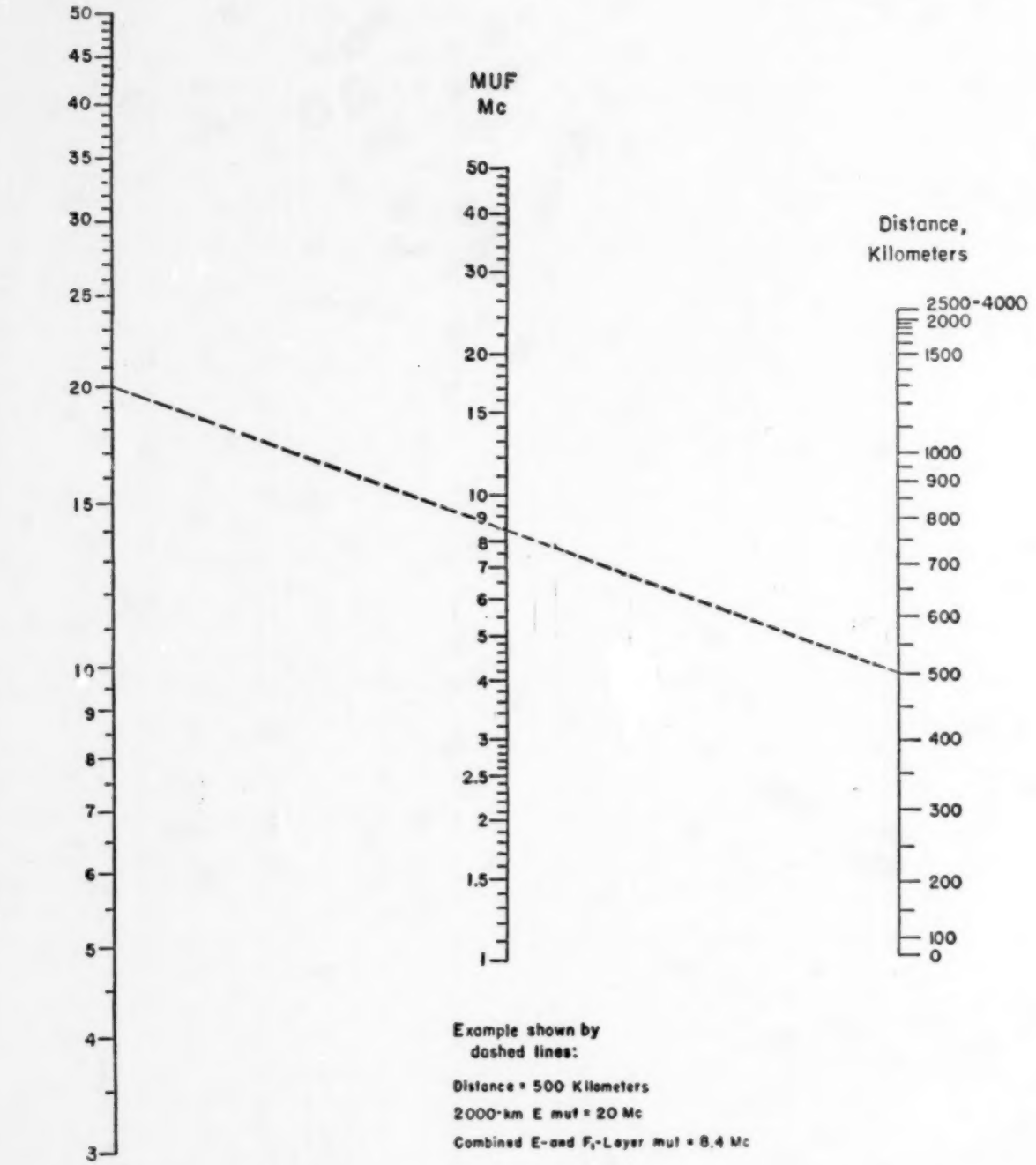


FIG. 11. PERCENTAGE OF TIME OCCURRENCE FOR Es-2000-MUF IN EXCESS OF 15 Mc, PREDICTED FOR AUGUST 1961


1 km = 0.62137 mile = 0.53961 naut. mi.
1 mile = 1.60935 km = 0.86836 naut. mi.
1 naut. mi. = 1.85325 km = 1.1516 mi.
DISTANCE IN KM
FOR VALUES OF MUF GREATER THAN 35 Mc, MULTIPLY ALL MUF AND FOT SCALES BY 2.
ZERO MUF
4000 MUF
MUF
FOT
LOCAL TIME

NOMOGRAM FOR TRANSFORMING F_2-ZERO-MUF AND F_2-4000-MUF TO EQUIVALENT MAXIMUM USABLE FREQUENCIES AT INTERMEDIATE TRANSMISSION DISTANCES; CONVERSION SCALE FOR OBTAINING OPTIMUM TRAFFIC FREQUENCY (FOT).

1 km = 0.62137 mile = 0.53961 naut. mi.
1 mile = 1.60935 km = 0.86836 naut. mi.
1 naut. mi. = 1.85325 km = 1.1516 mi.



NOMOGRAM FOR TRANSFORMING E-LAYER 2000-MUF TO EQUIVALENT MAXIMUM USABLE FREQUENCIES AND OPTIMUM TRAFFIC FREQUENCIES DUE TO COMBINED EFFECT OF E LAYER AND F_1 LAYER AT OTHER TRANSMISSION DISTANCES.

Notes on Use of Predictions

It is believed that these predictions are reasonably accurate for vertical incidence and for one-hop $F2$ transmission for average layer height for 4000-km distance over a great circle path. In practice, the picture is often more complicated. The effective antenna-radiated power at low angles of departure may not be sufficient for maximum single hop distance. Also, for a given distance various modes, or combinations of modes, of propagation are often possible, including combinations of E- and F-layer single or multiple hops. Ionospheric forward scatter, backscatter, off-great-circle transmission, and sporadic E may increase the actual MUF for a given circuit over that expected for the simplest great circle mode. Sporadic E may be particularly important during night hours in auroral zones, and during the middle of the day in the summer in temperate zones. Ionospheric layer tilt, horizontal ionization gradients, meteoric or auroral propagation may play an important part.

For many circuits, these may explain why the median MUF may give a better estimate of the FOT than the usual procedure of percentage reduction of the MUF. Use of operating experience in conjunction with these predictions will aid in maintaining the highest possible circuit efficiency.

Reports to this laboratory of discrepancies between predictions and experience are helpful in improving these predictions. Communications should be addressed to Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colorado. Please note this is not an address for subscriptions. Subscription information is given elsewhere in this report.

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CRPL—F. (Part A). Ionospheric Data.
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Limited distribution. These publications are in general disseminated only to those individuals or scientific organizations which collaborate in the exchange of ionospheric, solar, geomagnetic, or other radio propagation data.

Catalog of Data:

A catalog of records and data on file at the U. S. IGY World Data Center A for Airglow and Ionosphere, Boulder Laboratories, National Bureau of Standards, which includes a fee schedule to cover the cost of supplying copies, is available upon request.

The publications listed above may be obtained without charge from the Central Radio Propagation Laboratory, National Bureau of Standards, Boulder Laboratories, Boulder, Colorado, unless otherwise indicated. Please note that the F series is not generally available.

Circulars of the National Bureau of Standards pertaining to Radio Sky Wave Transmission:

NBS Circular 462. Ionospheric Radio Propagation. $1.25.
NBS Circular 465. Instructions for the Use of Basic Radio Propagation Predictions. 30 cents.
NBS Circular 557. Worldwide Radio Noise Levels Expected in the Frequency Band 10 Kilocycles to 100 megacycles. 30 cents.
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Selected Technical Notes of the National Bureau of Standards:

NBS Tech. Note 2. PB151361. World Maps of F2 Critical Frequencies and Maximum Usable Frequency Factors. $3.50. PB151361–2. $3.50.
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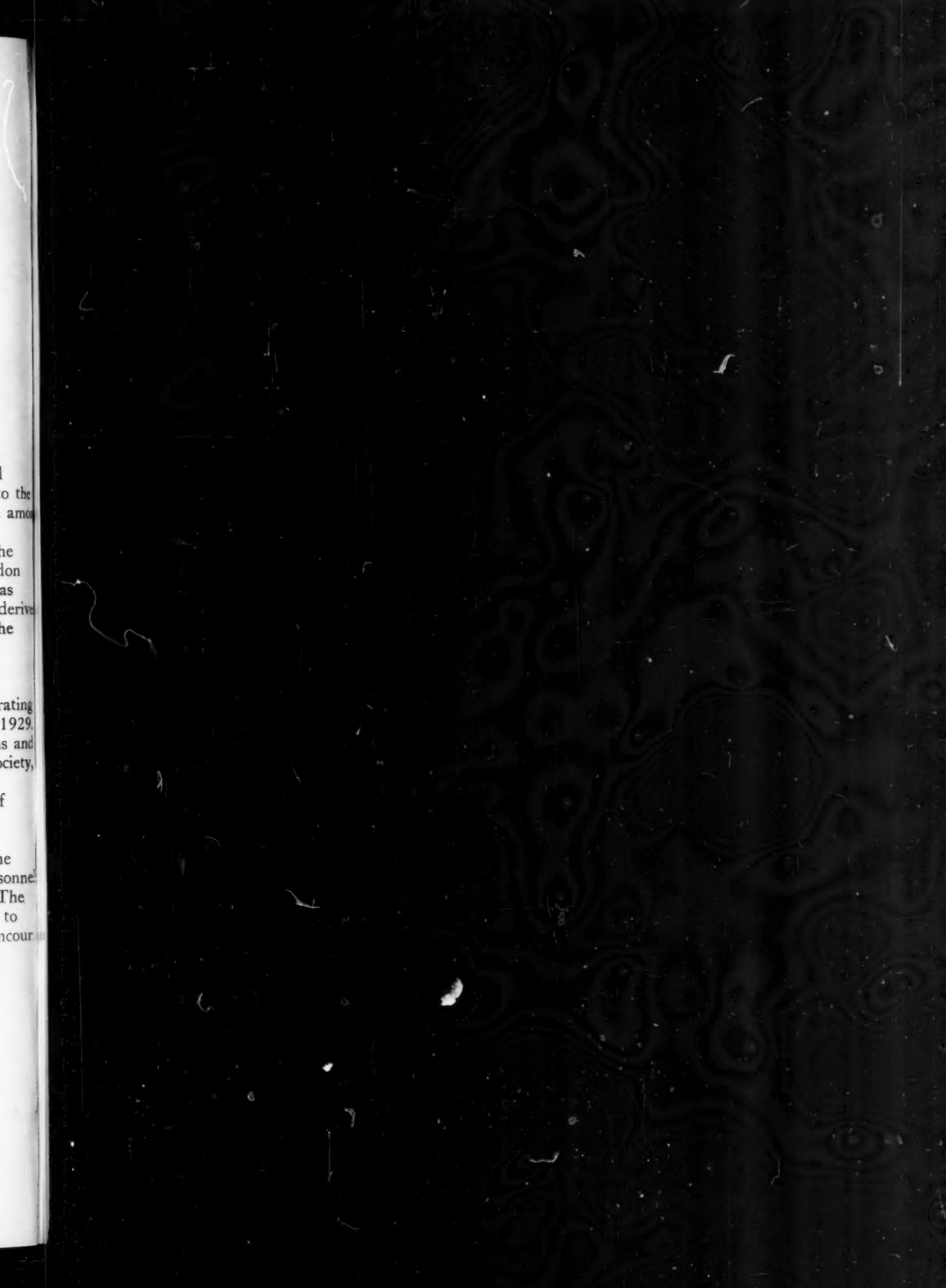
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